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CLASSIFICATION OF RETINITIS *

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The usual classification of retinitis is by etiology, as for instance, retinitis syphilitica, diabetica, etc., and no doubt this division is the best for clinical purposes. In another sense or etiologic classification, one may distinguish between a primary and a secondary retinitis. In the first case the primary seat of the inflammation is the retina itself, while in the second case, the inflammation passes into the retina from a contiguous tissue—for instance, from the choroid. From an anatomic standpoint one may distinguish a retinitis interna from a retinitis externa according to the primary involvement of the internal or external layers of the retina; or according to the class of inflammation, an alterative, exudative or proliferative retinitis. In the case of an alterative inflammation, degeneration of the histologic elements is predominant, as in retinitis albuminurica; in exudative retinitis, the exudation at the surface is prevalent, as in purulent retinitis. The proliferative retinitis distinguishes itself by the proliferation of the normal elements of the tissue, as in retinitis tuberculosa.

The inflammations in general may also be divided into parenchymatous and interstitial ones, according to the tissue affected in the first place. So in an inflamed gland it may be either the epithelium or the connective tissue stroma from which the inflammation starts. Applying this division to the retina, the tissue affected primarily may be either the epiblastic or nervous, or the mesoblastic or supportive part, the latter being the vessels with the accompanying connective tissue. This division is not less, but even more artificial than the others, as every real inflammation of the retina always starts from its mesoblastic part, the epiblastic tissue being involved only secondarily in the way of degeneration (nervous elements) or proliferation (neuroglia). Therefore, this division is not fit for clinical use, but a study from this standpoint of the various forms of retinitis in a wider sense facilitates the understanding of many otherwise obscure conditions. I may cite as an example retinitis pigmentosa. In this condition the tissue originates in the epiblastic part, in the visual epithelium (rods and cones) and in the pigment epithelium, and if the retinitis, as frequently is the case,

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is combined with deafness, it is the auditory epithelium of the cochlea which is affected. In angiomatosis of the retina (Hippel's disease) the pathologic condition starts from the mesoblastic tissue of the retina, i. e., the vessels which proliferate, the proliferation of the neuroglia being a secondary change. In these cases also angiomas may occur in the brain. In contradiction to these cases, in which analogous changes occur in different organs, one may find retinitis pigmentosa combined with polydactyly, or the sclerosis tuberosa of the brain and the retina combined with fibroma of the skin, etc., so that the disease at the same time originates in tissues developing from different embryonic layers. According to some authors, the condition in such cases may be accounted

Classification of Diseases of the Retina

First Neuron	Second Neuron	Third Neuron	Entire Nervous Part	Mesoblastic Part
A. **Congenital**	A. **Congenital**	A. **Congenital**	A. **Congenital**	A. **Congenital**
Albinism	Glioma	Tay-Sachs amaurotic idiocy	Microphthalmus	Angiomatosis retinae
Pigmentary degeneration	B. **Acquired**	B. **Acquired**	Coloboma	B. **Acquired**
Retinitis albescens	Exudation	**Primary:**	Conus	**Primary:**
Tapetoretinal degeneration	Transudation	Poisoning	Albinism	1. Abnormal condition of blood
B. **Acquired**	Cystic degeneration	**Secondary:**	Total blindness	Diseases of blood
Idiopathic hemeralopia (retinitis hepatica)	Separation in two layers in case of detachment	Interruption of nervous pathway	Congenital amblyopia	Toxic substances
Central scotoma from strong light				Clots
Poisoning by septolodol				Parasites
Gliosis of retina				2. Abnormal walls of vessel
Localized defects from folding				Spasm
Secondary:				Arteriosclerosis
Retinochoroiditis, detachment of retina				Syphilis
				Tuberculosis
				Nephritis
				Hemorrhages
				Edema (Berlin, Purtscher)
				Secondary:
				Retinitis after corneal ulcer iridocyclitis, purulent endophthalmitis

for by the assumption that the genes in the different affected tissues may be localized at contiguous points in the chromosomes.

In discussing the different classes of retinitis from the standpoint of the germinative layers, to which the primarily affected tissue belongs, I shall deal in the first place with the epiblastic part of the retina, composed of three neurons, and in the second place, with the mesoblastic tissue. Then the cases considered will be divided into those which are due to a congenitally abnormal condition and those brought about by obnoxious agents acting during extra-uterine life. The accompanying table shows this classification.

FIRST NEURON

The first neuron, also designated as neuro-epithelium, consists of the rods and cones and their nuclei, the external granular layer. The pigment epithelium with the neuro-epithelium forms an anatomic and physiologic unit, so that both tissues are always affected at the same time. All of the cases of this class are comprised under the common term of tapetoretinal degeneration.

Conditions that are congenital and therefore due to an anomaly of development are albinism and congenital hemeralopia, which are supposed to be due to an anomaly of the neuro-epithelium and the pigment epithelium. The same holds good for Oguchi's disease, which is also not progressive. A congenital anomaly may also develop so as to become apparent only later in life as retinitis pigmentosa or pigmentary degeneration. Related to this disease is retinitis albescens, sometimes, just as retinitis pigmentosa, combined with diminished hearing or deafness from degeneration of Corti's organ. Another similar disease is atrophia gyrata retinae et chorioidae. Finally, to this group of retinal diseases belongs the degeneratio tapetoretinalis, which unlike retinitis pigmentosa, starts from the central part of the retina. If the tapetoretinal degeneration develops during adolescence, and especially if it is hereditary or familial, there is no doubt about its being due to deficient development, and these cases may, like cases of retinitis pigmentosa, be complicated with lesions of the brain. There are similar cases which develop only in advanced age, and in these it is not possible to determine whether they also occur on the basis of an anomaly of development. To this group of cases belongs the senile degeneration of the macula lutea, as in a few of these, which could be examined anatomically, the choriocapillaris was found to be normal; so one must suppose that here also the degeneration started from the neuro-epithelium and the pigment epithelium, and not from the choroid.

As an acquired disease of the first neuron, I shall mention idiopathic hemeralopia. It is due to avitaminosis, and develops in some cases on the basis of pregnancy, alcoholism and diseases of the liver. The ordinary hemeralopia is temporary, but hemeralopia in consequence of diseases of the liver, which in these cases are chronic and incurable, leads eventually to changes in the fundus (retinitis hepatica) similar to retinitis pigmentosa.

Of exogenous agents affecting the first neuron, I shall first mention rays. Retinal lesions from light rays occur frequently after eclipses of the sun observed with the naked eye and reveal themselves by the presence of a central scotoma. Similar lesions may be produced by strong artificial light and also by roentgen rays. Many experiments have been carried out to produce such lesions artificially.

An acute lesion of the pigment epithelium and the neuro-epithelium may be provoked by poisonous substances, such as the proprietary septoiod, one of the various forms of the complex hypoiodite preparations, introduced by Pregl. If this is administered internally in toxic doses, it produces a sudden lessening of vision, the ophthalmoscope showing at first a gray turbidness of the retina due to edema, and developing later an irregular pigmentation, the so-called pepper and salt fundus. Experiments with septoiod poisoning in rabbits showed a granular disintegration of the neuro-epithelium and the pigment epithelium. Cases in which a reduction of sight and pigmentation of the fundus occur during the course of some infectious disease, such as typhoid, are also probably due to toxins.

A mechanical lesion of the neuro-epithelium of small clinical importance but interesting from the standpoint of pathogenesis may be observed under two different conditions. The first is present in eyes with extensive leukoma or marked staphyloma of the cornea, in which there develops slowly a degeneration of the retina termed gliosis retinae. In such cases the nervous elements of the retina disappear and are replaced by proliferating neuroglia, sometimes to such a degree as to increase considerably the thickness of the retina, into which pigment migrates from the pigment epithelium so that there results a picture similar to that of advanced retinitis pigmentosa. In both cases the disease starts from the neuro-epithelium. In retinitis pigmentosa this is due to some congenital defect; in gliosis, it is due to a mechanical destruction of the neuro-epithelium. This occurs as a sequel of the changes in the anterior part of the eye, by which the suspensory ligament of the lens is pulled forward and with it the anterior border of the retina, which in such cases is found to be considerably anterior to its normal place of insertion at the ora serrata. The advancement of the anterior border of the retina, if it occurs without detachment, supposes a gliding of the entire retina on the choroid, by which the rods and cones are pulled out of the pigment epithelial cells and eventually degenerate with the degeneration of the entire retina as a sequel. Another condition apt to damage mechanically the neuro-epithelium, although only in limited places, is the softening of the eyeball after perforation and escape of the contents. Then the sclera and the choroid reduce their surface to a certain extent by contraction, while the retina, not being contractile, forms small folds, followed by gliding of the retina on the choroid at the place of the fold. As a result, as in the cases of gliosis, the rods and cones are partly destroyed; if later the eye resumes its normal size and tension, the folds may disappear, but in their place lacunae persist in the neuro-epithelium. A secondary lesion

of the neuro-epithelium takes place in the case of detached retina, in which it degenerates because of separation from the nutrient choroid.

A secondary lesion of the pigment epithelium and of the neuro-epithelium also develops if the choroid is affected. In cases of acute inflammation of the choroid, as well as in cases of a high degree of myopia, the choroid and the pigment epithelium atrophy in consequence of stretching. With the loss of the pigment epithelium, the neuro-epithelium also degenerates. Colloid excrescences of the choroid, if large and penetrating into the neuro-epithelium, may also destroy this in certain places, so that if these excrescences are numerous and located in the region of the fovea, they may determine some reduction in vision.

SECOND NEURON

The second neuron comprises the inner granules, constituted mostly by the bipolar cells and by a minority of horizontal and amacrine cells. A disease of this layer, due to an anomaly of development, is the glioma, which develops from one of the two granular layers.

Regarding acquired diseases, because of the fact that the inner granular layer is included within the two capillary nets of the retina, this layer is especially predisposed to lesions originating from the vessels, such as hemorrhages, transudation and exudation. Like the external granular layer, the internal one is also a tissue of small resistance. The granules easily degenerate and disappear, leaving behind lacunae, which lead to cystic degeneration or even perforation of the retina. The cystic degeneration of the most anterior part of the retina is a common senile change and probably due to insufficient nutrition. The cystic degeneration of the posterior part of the retina, a frequent sequel of various diseases, as inflammations of various sorts, among which are those of tuberculous or syphilitic origin in the anterior part of the eye, is probably due to toxins emanating from the inflamed parts and acting on the retina; furthermore, glaucoma may occur, especially after thrombosis of the central vein of the retina, etc. Later there develop cystic spaces also in the intergranular and in the external granular layer, so that the retina becomes more and more separated into an internal and external layer, between which large cysts may develop.

The separation of the retina into two layers sometimes also takes place in certain cases of detachment of the retina, if it concerns only the inner layer, while the outer layer remains with the choroid. This occurs especially if the retina was adherent to the choroid previously, as in the cases with a high degree of myopia within the area of the circumpapillary atrophy, so that here the outer layers remain attached to the choroid if detachment supervenes.

Transudation into the inner granular and intergranular layer plays a great rôle in certain forms of retinitis, as retinitis albuminurica, diabetica, circinata, etc., in which the "beehive-like" masses visible in the specimens correspond to transudates coagulated by the hardening liquid.

THIRD NEURON

The third neuron is composed of the layer of ganglion cells and the layer of nerve fibers. Adhesions of these layers, due to congenitally anomalous conditions, are proved by the anatomic observations in cases of amaurotic idiocy of Tay-Sachs and of some similar cases occurring somewhat later in life (Stock-Spielmeyer's type). The first change in all these cases is the degeneration of the ganglion cells in the retina and in the brain.

Acquired changes, affecting in the first place the ganglion cells, occur in consequence of certain poisons. This has been proved by experiments in regard to methyl alcohol and quinine and arsenic compound, while in regard to methyl alcohol, tobacco, Filix-Mas (used against tapeworm) and other substances, the question is still under discussion. Furthermore, the ganglion cells die rapidly if they are cut off from nutrition in cases of obstruction of the central artery of the retina. Secondary degeneration of nerve fibers and ganglion cells is a necessary sequel of interruption of the nerve fibers in the optic nerve after division, simple or neuritic atrophy, atrophy of the nerve, from glaucoma and, on the other hand, atrophy of the external layers of the retina.

NERVOUS ELEMENTS IN ALL THE LAYERS

As a consequence of abnormal development, the retina is always found to be more or less affected in cases of malformations of the entire eyeball, as in microphthalmos or within the area of a coloboma of the choroid. A slight degree of underdevelopment exists in crescent-like atrophy on the lower, inner or upper side of the optic disk, designated as conus inferior, nasalis or superior, in which the retina of the sector corresponding to the side of the conus is thinner and the choroid is less pigmented so that when seen with the ophthalmoscope this sector appears lighter than the rest of the fundus. Corresponding to the incomplete development of the retina, the field of vision is narrower in the sector concerned.

An underdevelopment of the retina at the site of the yellow spot exists in cases of albinism, aniridia, congenital nystagmus and complete color blindness, and causes the acuity of vision to be lessened in these cases. Also amblyopia in otherwise normal eyes and in the absence of strabismus is often probably due to underdevelopment of the fovea centralis. Congenital amblyopia is found mostly in hypermetropic or

astigmatic eyes, usually affecting both eyes in the same degree. Amblyopia is greatest in childhood and becomes less during adolescence, without, however, disappearing entirely, so that vision always remains somewhat under par. In such amblyopic eyes the foveal reflex is often absent, even if the patient is young, a proof that the normal groove at the fovea does not exist or is at least too shallow to give a perceptible reflex at its slopes. In fact, anatomic examination of such eyes shows the foveal depression either entirely absent or shallow, because, on one hand, the ganglion cells do not accumulate as normally at the border of the fovea in numerous layers, and on the other hand, a single or double layer of ganglion cells covers the floor of the fovea. In exceptional cases even a thin layer of nerve fibers was found to be on the ganglion cells. This condition corresponds to an arrest of development at an earlier stage, because it is only after the sixth fetal month that a central groove begins to develop, which, however, attains its full depth only in the third or fourth month of extra-uterine life. The thin layer of ganglion cells and even of nerve fibers at the floor of the fovea is not a sufficient obstacle to vision to account for the amblyopia, so that one must assume in addition a defective development also of the other constituents of the retina at the fovea centralis.

MESOBLASTIC PART OF THE RETINA

There is little mesoblastic tissue within the retina, as it is found only in the walls of the retinal vessels and their lymph sheaths, both consisting of connective tissue. A still smaller amount of mesoblastic tissue is found in the branching cells in the third neuron, discovered recently by Rio Hortega. There is, therefore, connective tissue only in the inner layers of the retina. In the retina the vessels are not so intimately connected with the adjoining tissue as in other organs. Many animals possess a retina without any vessels. In the eyes, in which the retina is provided with vessels, these penetrate into the retina from its inner surface only at a comparatively late stage of development. In inflammation of the retina in infants it is remarkable how the vessels protrude over the inner surface of the retina so that they seem to lie on it. There is little vascularization of the retina as there are vessels only in the inner layers of the retina and no vessels in the fovea.

The new formation of vessels in the retina in adolescents, designated as Hippel's disease or angiomatosis retinae, is considered a consequence of an anomaly of development. Since beside the vascular new growth, there is also a proliferation of neuroglia, some consider this as the primary lesion. The fact that in some of these cases there are also cysts of the cerebellum with angiomas, or vascular tumors, in the spinal

cord and in the liver favors a diagnosis of angiomatosis, that is, primary new formation of vessels.

An acquired disease is the disk-shaped degeneration of the macular region. It develops in more advanced age and is usually bilateral. The anatomic change is a membrane between the retina and the choroid, sharply delimited toward the choroid, so that it is supposed to originate from the pigment epithelium and the capillaries of the retina.

Diseases of the retina originating in the vessels are due to an abnormal condition either of the blood or of the walls of the vessels. In the first case one may have to deal with diseases of the blood as hyperglobulia (polycythemia), pernicious anemia, leukemia, etc., which are so often complicated by retinal hemorrhages, or the blood may contain poisonous substances, whether poisons, strictly speaking, as in the cases of poisoning mentioned, or toxins. Such poisons, doubtless, play a great rôle in many cases of retinitis, for example, in albuminuric retinitis. The blood may also carry corpuscular elements, which may form within the blood as clots, obstructing retinal vessels by embolism or thrombosis; or these elements may be aliens in the blood, as parasites, which in milder cases cause retinitis septica Roth and in severer cases, a metastatic retinitis terminating in panophthalmitis. In most cases, the parasites are the ordinary bacteria, such as pneumococcus or streptococcus, but in several acute or chronic infectious diseases, it is the specific parasite which causes a metastatic inflammation. Metastatic in a wider sense are the chronic inflammations caused by the parasites of tuberculosis and syphilis. The retina has little predisposition to tuberculosis, which as a rule is transmitted to the retina only from a tuberculous choroiditis. Primary tuberculosis of the retina is rare and occurs most frequently in young men as tuberculous periphlebitis, revealing itself by recurrent hemorrhages into the vitreous body. On the other hand, the retina is a good medium for spirochetes, emigrating from the blood into the retina, setting up inflammation. In many cases of syphilitic inflammation of the retina the foci are on retinal vessels, and the same holds good for tuberculous foci.

Regarding the rôle played by the wall of the vessels, the trouble may be functional or organic. If it is functional, spasm occurs, without obvious anatomic changes. If the spasm is such as to intercept the circulation completely, and if it lasts long enough, the corresponding area of the retina shut off from the blood supply will cease to function and will finally become atrophied.

Whether albuminuric retinitis is due to a permanent spasm of the retinal vessels, as Volhard holds, who therefore, terms this disease retinitis angiospastica, or whether the retinitis is caused by substances retained in the blood because of insufficient function of the kidneys

or by some other toxic substances, has not yet been ascertained. Spasm of the retinal vessels plays the main rôle in cases of poisoning by quinine and optochine. More often organic or anatomic alterations of the walls of the vessels lead to narrowing or to complete obstruction of retinal vessels or to hemorrhages. Organic changes in the retinal vessels are usually due to arteriosclerosis, syphilis, tuberculosis (recurrent hemorrhages in young men) or nephritis. They are the cause, especially in old age, of many cases of retinal hemorrhages, of blindness following obstruction of vessels and of some forms of retinitis, i. e., retinitis circinata.

Abnormal permeability of the vessel walls may lead to hemorrhage by diapedesis, frequent in diseases of the blood. With less permeability the walls of the vessel allow only blood plasma to pass into the retinal tissue, producing the edema which so often accompanies inflammation of the retina. Retinal edema may also develop without inflammation as a temporary condition, without known cause (acute edema of the macula region, Mizou's phenomenon in Oguchi's disease), after contusion, as in the cases described for the first time by Berlin, as a result of compression of the thorax or after a fall on the head. This condition was described as angiopathia retinae by Purtscher.

Hemorrhages subsequent to rupture of vessels, if not of traumatic origin, must be ascribed to a morbid condition of the wall of the vessel which causes it to break even when the blood pressure is normal and still more readily if the pressure is increased.

In the instances cited, the disease of the retina is primary, because it is not due to propagation of the inflammation from contiguous tissues as in cases which should be designated as secondary retinitis, of which the most frequent instance is retinochoroiditis in which the primary lesion is located in the choroid. In other cases the transmission of the inflammation is indirect if it is transmitted to the retina from some distant focus of inflammation. This is true of many inflammations of the anterior parts of the eye, especially iridocyclitis, if they become complicated with retinitis. As a rule, this cannot be seen with the ophthalmoscope because of the diminished transparence of the media in such cases, but it may be guessed at by the fact that the acuity of vision is reduced more than can be accounted for by the turbidity of the media, or by the presence of a central scotoma. Even in the case of a large, though not perforating, corneal ulcer, which permits of an ophthalmoscopic examination, one often finds the retinal vessels engorged and accompanied by white lines. In such cases the anatomic examination shows accumulations of lymphocytes within the lymph sheath of the veins, periphlebitis retinae. This condition is not due to direct action of bacteria, as they are not present in the interior of the eye, but only in

the cornea. But from there they pass into the anterior chamber and through the vitreous body to the retina.

If bacteria get into the vitreous body, they cause a much severer purulent retinitis, although they do not penetrate into the retinal tissue. This is the case only in metastatic retinitis.

For better understanding, the lesions of the different constituents and layers of the retina were dealt with separately. In reality the conditions are much more complicated and intricate. A determined obnoxious agent may act on the tissue in different ways at the same time, and different tissues may be affected simultaneously by the same agent.

ENDOCRINE STUDIES

XXIV. THE ETIOLOGY OF GLAUCOMA *

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In view of the frequently expressed opinion that glaucoma results from disturbed endocrine function, the following brief note may be of some interest.

The patients studied were referred from the regular service of the Massachusetts Eye and Ear Infirmary and constituted a consecutive series of thirty-one, all of whom had been demonstrated to have glaucoma. Experience has shown that in all of the established endocrinopathies, measurements of the so-called basal metabolic rate show significant divergence from conventional normal values, although in such cases the single observation of the oxygen requirement is rarely competent to define the gland at fault. Pituitary and thyroid cases in a state of transition between an initial hyperfunctional and a final hypofunctional level may fortuitously exhibit normal rates if observed while passing through the normal zone. Rarely, if ever, will such cases fail to show other stigmas suggesting an endocrine disorder.

Since departures from the conventional normal suggest though they do not define an endocrine disorder, this measurement was adopted as the first criterion of a possible endocrine influence and was repeated until authoritative data were obtained. The patients who showed significant deviation of the basal rate from normal standards or gave other evidence of a possible ductless glandular involvement were next studied by a method (designated as the "short form") already described,[1] the program of which included the clinical evidences of a detailed medical history and carefully complete physical examination, together with the qualitative and quantitative examination of a twenty-four hour collection of urine, the nitrogen partition, chemical analysis of the blood, morphology and serology, the "phthalein" test and determination of the vital capacity, alveolar carbon dioxide and an additional measurement of the basal rate with its essential complementary records

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* From the Evans Memorial.

* The present article records a minor study undertaken in connection with the comprehensive investigations that have been conducted at the Massachusetts Eye and Ear Infirmary by Dr. George S. Derby and his associates.

1. Rowe, A. W.: Boston M. & S. J. **190**:291, 1924; Endocrinology **12**:1, 1928.

of pulse rate, blood pressure and temperature. To this routine procedure were added such special consultations as were indicated by the needs of the individual patient.

When such study was inadequate to determine a just conclusion as to an underlying endocrine condition, the patient was hospitalized for a week or more and a much more elaborate and complete study (designated as the "long form") was undertaken. As this has already been described elsewhere,[2] the details may be omitted. The end-results of the complete survey may be compactly presented in tabular form (table 1).

TABLE 1.—*Diagnostic Summary*

	Basal Rate	Short Form	Long Form
Not endocrine	18	5	1
Endocrine	0	0	1
Incomplete	4	2*	0

* Both possibly endocrine.

TABLE 2.—*Analysis of First Nonendocrine Group*

Number	18	Respiration: High	24
Male	12	Low	9
Female	6	Average	16
Age, years: High	72		
Low	46	Temperature, F.: High	98.8
Average	57	Low	97.0
Basal rate: High	+13%	Average	98.2
Low	− 6%		
+ average	+ 7%	Blood pressure, mm.	
per cent	72	Systolic: High	216
− average	− 3%	Low	104
Per cent	28	Average	145
Grand average	+ 4%		
Pulse rate: High	83	Diastolic: High	122
Low	58	Low	54
Average	73	Average	80

The group of eighteen designated as "nonendocrine" on the basis of the first examination showed normal basal rates and gave no other dependable evidences of disorder of the ductless glands. The data from the group are collected in table 2.

A few pulse and respiration rates were recorded that did not agree with the usual normal figures. Repetition, however, showed them to be characteristic of the individual patient. Likewise, there were several cases of hypertension, again a departure from the normal but a condition not defining endocrine disease.

The four patients in this group whose cases are designated as incomplete failed to return for further study. As they compose a part of the series, the actual data may be considered (table 3).

2. Rowe (footnote 1, second reference).

Case 9 was frankly not basal, the patient being reported as restless. That the recorded value is too high is certain; the true level is not even a matter of conjecture. The serious error that even slight movement or nervous tension can introduce into this magnitude is too well known to require discussion.

Cases 13 and 27 were probably not endocrine. Further study of the first was requested because of the somewhat unusual age at which this patient had glaucoma and for a slightly rapid respiration rate. The second case was regarded as probably nonendocrine, and further study was requested only for confirmation. The fourth in the group, case 29, was felt not to be basal, as the temperature was slightly high and the pulse pressure was unduly large. Nervous instability will affect this by raising the systolic pressure. Although the patient was reported as quiet, additional study was felt to be indicated.

Reference to table 1 shows six patients who failed on further study to demonstrate evidence of endocrine disease. Such of the pertinent data as permit of collective presentation are collected in table 4.

TABLE 3.—*Analysis of Incomplete Cases*

Case	Sex	Age	Basal Rate, per Cent	Pulse Rate	Respiration	Blood Pressure	Temperature, F.	Comment
9	M	66	+32	77	14	104/63	98.4	Not basal; values inconsistent
13	M	32	— 2	62	20	108/68	98.0	Nonendocrine ?
27	M	54	— 6	63	14	140/86	97.8	Nonendocrine ?
29	F	62	+ 8	79	19	196/72	99.0	Not basal

Case S 543 presented an entirely normal picture for a man of 62 years, and his history and physical examination were equally free from evidence of an existent endocrinopathy. In case B 307, the patient was one of the two who had been given the "long form" study involving hospitalization. There was no evidence of an endocrine condition, but cardiorenal disease and a significant prostatic condition were demonstrated. In case S 556, the patient had a demonstrated hepatic dysfunction, to the metabolic influence of which his somewhat low basal rate was traceable. S 572 was another cardiorenal case with definite hypertension. Certain facts in the complete study suggested the possible presence of a syphilitic taint. The Wassermann reaction of the blood was negative, and a lumbar puncture could not be secured. The case, however, was certainly not endocrine. In case S 562, the Wassermann reaction was 3+. In spite of some degree of overweight, the protein intake was far from liberal, and the borderline value shown by the basal rate was devoid of an endocrine suggestion. The last case, S 641, gave evidence of an early nephritic condition but nothing suggesting an endocrinopathy. As a whole, the general performance

of the group was not in any way consistent with any of the disorders of the ductless glands.

The three remaining cases, on the other hand, suggested an endocrinopathy, which in one case was proved to be present. The same significant data from these cases are collected in table 5 as a basis for the discussion of each.

CASE S 592.—A woman, aged 52, complained of blindness of the right eye following an operation for glaucoma eighteen months earlier. The onset of the underlying condition had been three years earlier.

TABLE 4.—*Nonendocrine Cases*

Data	S 543	B 307	C 556	S 572	S 562	S 641
Sex	M	M	M	M	F	M
Age, years	62	64	55	69	53	51
Height, cm.	164	174	172	166	164	169
Weight, Kg.	71.5	69.2	79.5	67.6	71.5	62.0
Weight deviation, per cent	+15	+4	+21	+7	+21	−6
Lung volume deviation, per cent	−31	+5	−16	−24	−33	−6
Basal rate deviation, per cent	+7	−7	−15	+20*	−11	−11
Blood pressure, mm.	156/92	156/86	102/98	230/112	148/90	116/70
Pulse rate	81	52	58	73	64	63
Temperature, degrees F.	98.8	98.0	97.8	98.4	97.0	98.4
Alveolar carbon dioxide, mm.	36	37	32	39	33	34
Urine volume, cc.	1,340	1,790	800	1,810	1,630	870
Specific gravity	1.025	1.010	1.025	1.015	1.016	1.028
Albumin	0	+	0	+	0	0
Casts	+	+	0	0	0	0
Sugar	0	0	+	0	0	0
Urobilinogen	0	0	+	0	0	0
Total nitrogen, Gm.	17.05	8.83	9.02	11.51	8.21	11.34
Residual nitrogen, per cent	5.2	19.0	5.9	13.8	7.1	6.8
Phenolsulphonphthalein, per cent	60	<10	48	57	75	45
Blood nonprotein nitrogen	30	128	39	44	28	51
Urea nitrogen	15	60	19	23	13	21
Uric acid	3.2	4.5	3.2	4.2	..	3.9
Sugar	100	100	100	95	95	110
Hemoglobin	95	90	80	75	70	80
Erythrocytes	5,700,000	4,530,000	5,840,000	4,280,000	4,720,000	5,500,000
Color index	0.83	0.99	0.68	0.86	0.75	0.73
Leukocytes	6,400	5,100	7,800	4,350	12,100	9,600
Neutrophils	67	62	63	80	47	60
Lymphocytes	32	35	33	15	38	30
Eosinophils	1	2	1	2	3	1
Wassermann reaction	0	0	0	0	Doubtful	0
		Cardiorenal; prostate	Renal; liver	Cardiorenal; syphilis?	Syphilis?	Renal

* Not basal. Earlier values normal.

The history was not remarkable; the physical examination showed the teeth to have been removed, varicosities in both legs, a moderate lordosis, some facial hypertrichosis and a moderate obesity, with a tendency toward girdle distribution. The volume of urine was scanty; the protein intake was scanty and at a low maintenance level; the residual nitrogen fraction was high; the uric acid of the blood was relatively high, and a basal rate of +26 per cent was confirmed by several concordant observations. She was somewhat overweight, and the lung volume was somewhat below prediction. There was tachycardia, secondary anemia and a high normal blood pressure. (An earlier history reported definite hypertension.)

The patient could have had a mild degree of hyperthyroidism or a pituitary condition. Information concerning the sugar tolerance would have done much to resolve this question and was requested but not secured. This case is reported as unclassified but possibly of endocrine origin.

CASE S 631.—A woman, aged 53, complained of fatigability of several years' standing, together with the loss of vision in the left eye two years previously and impairment of the right eye of some months' standing, both as the result of glaucoma. Both eyes had been operated on, the second operation being successful. The patient had a normal marital history with six successful pregnancies. She complained of nausea, vomiting, constipation, pain in the head, syncope, nocturia, urgency and frequency. The menstrual history was normal, including an uneventful menopause a year previously. Physical examination showed the fontanels somewhat broader than usual and depressed, dubious tonsils and some hypertrichosis on the face and extremities. The urine was normal; the protein intake was at a low maintenance level and the residual nitrogen was high. Her lung volume was significantly below prediction; the basal rate was —13 per cent, with fairly normal physical observations. There was a secondary anemia, with a 3 per cent eosinophilia. The general picture suggested a pituitary dysfunction without defining it. Information concerning the sugar tolerance was requested both to confirm the pituitary suggestion and, if positive, to define the function levels of the posterior lobe. I was unable to secure this essential datum.

TABLE 5.—*Possible Endocrine Cases*

	S 592	S 631	B 819
Sex	F	F	F
Age	52	53	55
Height, cm.	151	155	154
Weight, Kg.	58.1	62.6	56.5
Weight deviation, per cent	+16	+15	+18
Lung volume deviation, per cent	−21	−35	−28
Basal rate deviation, per cent	+26	−13	−22
Blood pressure, mm.	150/90	120/84	140/82
Pulse rate	118	68	75
Temperature, degrees F.	98.9	98.6	97.8
Alveolar carbon dioxide, mm.	36	35	41
Urine volume, cc.	490	1,350	900
Specific gravity	1.028	1.013	1.014
Albumin	0	0	+
Casts	0	0	+
Sugar	0	0	0
Urobilinogen	0	0	0
Total nitrogen, Gm.	7.64	7.82	4.91
Residual nitrogen, per cent	16.8	10.5	9.1
Phenolsulphonphthalein, per cent	56	71	48
Blood nonprotein nitrogen	28	30	37
Urea nitrogen	14	12	17
Uric acid	3.5	3.0	3.5
Sugar	127*	89	104
Hemoglobin	75	70	80
Erythrocytes	4,160,000	4,250,000	4,340,000
Color index	0.90	0.82	0.92
Leukocytes	7,300	7,300	5,850
Neutrophils	63	66	57
Lymphocytes	30	30	31
Eosinophils	0	3	1
Wassermann reaction	0	0	0

* Above the truth; emotional response.

Again the case is incomplete and can be recorded only as unclassified but presenting some evidence of a pituitary disorder.

The third case was thoroughly studied and the diagnosis established.

CASE B 819.—The initial study was carried out in February, 1925, the presenting complaint being a blurring of vision. A "short form" study was carried out, and the conclusion was reached that there was a definite endocrinopathy but that further study would be necessary to determine the gland at fault. A "long form" study was requested but not secured, and the case was listed as "unclassified endocrine."

In September, 1927, the patient returned to the hospital with a request for a thorough study. The results may be briefly summarized.

A woman, aged 55, complained of pain in the right side of two or more years' duration. She had been under treatment for glaucoma since her initial contact. The family history showed tuberculosis and cancer in her parents. During her own married life, she had conceived twice but both pregnancies had ended in miscarriage at five and seven months, respectively. Renal complications with the second pregnancy indicated the unwisdom of further conception. She reported the usual minor ailments of childhood and scarlet fever. She complained of headache, a few attacks of vertigo, the condition of the eye with its associated

TABLE 6.—*Review of Available Data*

Endocrine established	1	27	4%
Endocrine doubtful	2		7%
Not endocrine, established	24		89%
Incomplete	4		
Total	31		

symptoms, unilateral deafness with tinnitus, slight nasal obstruction and an earlier susceptibility to tonsillitis which, however, had not been troublesome for several years. There was an earlier record of dyspnea, palpitation and some subxiphoid pain. The menstrual history was negative, including a relatively uneventful menopause, four years previously. She complained of easy fatigability, minor paresthesias and some "backache."

The pain which constituted the patient's chief complaint had begun two years or more previously and had been fairly continuous. It tended to localize in the area of the gallbladder. Beyond obstinate constipation for several years, the gastro-intestinal history was not suggestive.

The physical examination, outside of the condition of the eye, showed hypertrophied turbinates, dubious tonsils, some tenderness over the gallbladder, some scoliosis, a definite exaggeration of the lumbosacral angle and minor arthritic changes in the hands.

The urine showed albumin and casts, the protein metabolism was low, and the residual nitrogen fraction was above normal. The blood showed a slight secondary anemia; the chemical analysis of the blood revealed a slight relative increase in nonprotein nitrogen, the more significant as the protein exchange was so low. The patient was 18 per cent above the predicted weight, and the lung volume was definitely diminished. The basal rate was 22 per cent below prediction, with normal associated physical measurements. The "phthalein" elimination was somewhat low; the alveolar carbon dioxide was normal.

Cystoscopy showed a filling defect of the right kidney, indicating a possible tumor growth. These observations were confirmed by repetition. Exploratory

incision was requested and refused. The examination of the eye gave observations conditioned by the glaucoma. A pelvic examination gave negative results; that of the nose and throat was substantially negative, and the tonsils were considered as nonoffending. A roentgen study of the head gave negative results. Examination of the ear showed a dry catarrh; the audiogram showed some loss of hearing; the Bárány test demonstrated sluggish responses. A neurologic examination gave negative results except for somewhat sluggish reflexes; the liver function test (McClure) showed disturbance in biliary function. A Graham test by the oral route was negative; the test with intravenous injection could not be secured. The urea index was normal, indicating at least one effective kidney.

The patient had a demonstrated hepatic dysfunction, possibly associated with disease of the gallbladder. There was a suggestion of renal tumor which, like the condition of the gallbladder, was not evaluated, as permission for additional study was withheld. Finally, there were a number of facts pointing to a mild thyroid failure which was regarded as wholly secondary in importance to the other demonstrated and suggested pathologic changes of a nonendocrine character.

The bearing of the thyroid failure on the glaucoma must be considered as somewhat remote.

Review of the available data gives the result shown in table 6.

Only one of the twenty-seven cases with some claim to completeness was certainly endocrine. Twenty-four were as definitely without evidence of involvement of the ductless glands. One of the two doubtful cases, not completely studied, was probably endocrine and the other was not by about the same margin. With so small a putative endocrine representation, a glandular etiology is hard to trace, and if the consideration is limited to the established cases, there is no real evidence of an endocrine background for the condition of the eye. It seems warranted to conclude that there is no real evidence in this series to support the contention that there is a significant endocrine factor in the etiology of glaucoma.

METASTATIC BACILLUS COLI PANOPHTHALMITIS FROM CALCULUS PYONEPHROSIS *

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Metastatic panophthalmitis is not uncommon, but *Bacillus coli* infection in such cases is extremely rare; furthermore, there is no recorded case of proved endophthalmitis from infection of the kidneys. The organisms most commonly isolated have been *Staphylococcus, Meningococcus, Streptococcus* and *Pneumococcus,* the etiologic factors in these cases having been meningitis, lobar pneumonia, grip, puerperal sepsis, epidemic parotitis, measles, cholecystitis and tuberculous disease of the joints.

In a personal communication, Dr. Goldstein of New York told me of an unreported case of endophthalmitis under his care in which *B. coli* was isolated from the eye and from the ethmoids, the latter being considered the etiologic focus. Betti [1] described two cases of contusion of the globe resulting in *B. coli* panophthalmitis, but the original focus was not determined. Oreste [2] reported a case in which a patient, aged 60, had metastatic choroiditis, but he was not able to determine whether intestinal disease or an existent urinary inflammation was the cause. Morax studied the organism obtained from the eye in this case and found a small gram-negative bacillus which was segmented in the middle, immobile and not fermenting the sugars, so that it could not be definitely classified as a colon bacillus.

Luttringer [3] recorded six cases of metastatic infection of the eye during puerperal fever, all of which were fatal; he also cited Axenfeld's compilation of sixty-nine cases in twenty-seven of which both eyes were involved and in which 66 per cent of the patients died. Terrien [4] reported a case of cholecystitis and cholelithiasis with an attack of fever and jaundice followed by suppurating iridocyclitis with hypopyon, from which he isolated *Pneumococcus.* He also had another case following abscess of the prostate; in this, *Staphylococcus* was obtained. Touzet [5] had a case of pneumococcic panophthalmitis in a negro, following the

* Submitted for publication, Jan. 23, 1930.

* From the Eye Service of the Manhattan Eye, Ear and Throat Hospital.

1. Betti, L.: Colon Bacillus Infection of the Eye, Riforma med. **35**:784, 1919.
2. Oreste, A.: Metastatic Choroiditis, Ann. d'ocul. **143**:373, 1909.
3. Luttringer, P.: Metastasis in the Eye from Puerperal Infection, Gynéc. et obstét. **5**:513, 1922.
4. Terrien, F.: Metastatic Ophthalmia, Ann. d'ocul. **159**:460, 1922.
5. Touzet: Pneumococcic Panophthalmitis, Arch. d'opht. **38**:372, 1921.

crisis in double pneumonia. Verhoeff [6] reported a case of metastatic intra-ocular mycosis; Thies,[7] a case of metastatic ophthalmia after angina; Mansilla,[8] cases after typhoid fever; Fernandez,[9] cases after measles; Lundsgaard,[10] cases from mumps; Stock,[11] cases from tuberculous disease of the joints and Samperi,[12] cases in influenza. Jaendelize [13] in describing metastatic ophthalmia in children, stated that the most common causes in these patients are cerebrospinal meningitis, grip, pulmonary infections and gastro-intestinal disturbances.

As to experimental work in metastatic panophthalmitis, that done by Selenkowsky and Woizechowsky [14] is best known. Using the eyes of rabbits and cats, they found that it was possible to introduce bacteria into the vitreous directly from the blood vessels of the posterior portion of the eye. In cases of severe general infection with many organisms circulating in the blood, the bacteria passed into the vitreous of normal, nonirritated eyes. With mild infection of the blood stream, entrance into the vitreous occurred only when the eye had been injured shortly before. Injury to both the anterior and the posterior portions of the globe was found most favorable for the entrance of bacteria into the eye, injury to the posterior portion alone next most favorable and injury to the anterior part alone by far the least favorable.

The pathologic process often begins in the ciliary body, with secondary abscesses rupturing into the vitreous. There are three types of inflammation: (1) an intense inflammation, with symptoms of panophthalmitis and possible rupture; (2) iridocyclitis with hypopyon, vitreous complications and eventful atrophy, and (3) an insidious, slightly inflammatory condition which becomes gradually apparent and, in children, simulates glioma.

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6. Verhoeff, F. H.: Metastatic Intra-Ocular Mycosis, Arch. Ophth. **55**:225 (May) 1926.

7. Thies, O.: Metastatic Ophthalmia After Angina and After Measles, Klin. Monatsbl. f. Augenh. **77**:379, 1926.

8. Mansilla, G.: Metastatic Panophthalmitis from Typhoid, Rev. cubana de oft. **4**:136, 1922.

9. Fernandez, F. M.: Ocular Complications of Measles, Rev. cubana de oft. **3**:159, 1921.

10. Lundsgaard: Cyclitis with Parotitis, Klin. Monatsbl. f. Augenh. **57**:393, 1916.

11. Stock. W.: Metastatic Ophthalmia Through Tubercle Bacilli, Klin. Monatsbl. f. Augenh. **70**:356, 1923.

12. Samperi: Metastatic Panophthalmitis in Influenza, Gior. di med. mil. **67**: 597, 1919.

13. Jaendelize: Metastatic Ophthalmia in Children, Médecine **6**:276, 1925.

14. Selenkowsky, J., and Woizechowsky, N.: Experimental Work on Metastatic Panophthalmitis, Arch. f. Augenh. **47**:299, 1903.

REPORT OF CASE

B. C., a white man, aged 38, presented himself at Dr. Fletcher's clinic for examination because of pain and redness in the right eye for the previous twenty-four hours. One day prior to the onset of the present complaint, he had an attack of left-sided renal colic; he had been subject to similar attacks for six years. About seven years before the patient appeared at the clinic, the right kidney was removed because of calculus pyonephrosis.

Examination of the right eye showed moderate circumciliary injection, a normal pupil and iris, no keratitis punctata, a slightly turbid aqueous and a normal fundus; vision was 20/20. There was decided tenderness on palpation. Atropine sulphate and hot fomentations were prescribed, with acetylsalicylic acid for the pain. The next day there was edema of the upper lid, limitation of mobility of the globe, extreme injection and hypopyon; vision was limited to perception of hand movements. The patient was admitted to the hospital and routine treatment instituted, including the intramuscular injection of 10 cc. of whole milk. His temperature was 99.8 F. by rectum, and at no time did it rise higher. No blood culture was taken. The following day, there was bulging of the sclera, 4 or 5 mm. temporal to the limbus. An incision was made here to allow escape of the pus, a culture of which was made from the interior of the globe; evisceration was then performed. Healing was uneventful, and at no time was the left eye involved.

The report on the culture taken from the vitreous was a pure growth of *B. coli,* with characteristic morphologic and cultural observations. This, in conjunction with the renal history, led me to take a culture of a catheterized specimen of urine, which also showed a pure growth of *B. coli.* The routine examination of the urine showed the presence of albumin, pus cells and granular and hyaline casts.

EYE CONTOUR A VISUAL FACTOR*

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The eye has optical errors. But Helmholtz' famous dictum that the monochromatic aberrations of the eye are such as would not be tolerated in any good optical instrument should not, as has been done on some occasions, be taken to condemn the eye in all its functions. For, in some respects, it is far superior to any optical instrument built by man. In the matter of spherical aberration the eye is inferior to many man-made optical instruments, the eye not being made to overcome optically color aberration. It was to this fault, and to nothing else, that Helmholtz had reference when he uttered his famous dictum, so frequently misquoted.

Man-made optical instruments overcome chromatic aberration by the use of lens combinations composed of one convex element of crowned glass, which is more convergent for blue than for red, and another concave element of flint glass, which is more divergent for blue than for red. By combining these elements in the proper amount and within the proper curves, the dispersive effects of one element can be neutralized by the other. In the case of the human eye, however, this has not been possible because of the constant flexions which the lens is called on to make during accommodative change. Practically all of the change of curvature occurring during accommodation takes place on the anterior lens surface. In a lens system well corrected against chromatic aberration, there would have to be equal changes; also the required convergence would be divided between two lens elements. Hence because of the change of curvature that occurs almost exclusively in the anterior surface during the accommodative process, it is self-evident that no attempt has been made to maintain the nicety of fixed curves which is necessary to obtain color correction in the man-made instruments.

Nature chose to give us a more alert, more accommodative eye than would be possible were chromatic aberration corrected in the lens system. In this matter we have learned to use a defective instrument; for through the agency of perception it is possible to interpret properly the data supplied. We probably focus separately for the red and blue

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images, retaining a memory image of the one to combine, through the agency of our perceptions, with the actual image of the other color. At any rate, our interpretation is not seriously impaired because of any lack of color correction in the optical system of the eyes.

Likewise, in the case of spherical aberration, a perfected mechanism capable of overcoming chromatic effects incident to spherical aberration would require that the eyes have a double lens system, dividing equally the power of the present lens. This again would complicate materially the accommodative mechanism. Nature either deemed this accommodative function more essential to our welfare or found that correction for color aberration was possible by other and simpler methods. Probably the latter is the truer version. Besides our perception to help us in the proper interpretation of color images, our chromatic understanding is much simplified by nature's having limited sensitivity to color to a narrow part of the retina. The photographic plate is equally sensitive all over, whereas the retina is keenly sensitive only about the macula. The portions of the retina in which the color defects would become increasingly bewildering are decreasingly supplied with end-organs capable of color differentiation. The cones, supposedly having to do with color differentiation, are decreasingly present as the retina is traversed in the direction from the fovea, where they are present in the greatest numbers, toward the ora serrata, where they are completely absent. Nature was careful to limit our sensitivity to color close to the visual axis which passes through the fovea. Chromatic aberrations are least offensive in the case of images that fall close to the visual axis. The correction, then, for the color aberrations, the greatest optical fault with which the eyes are afflicted, is a correction dependent on the minuteness of the image and the placement of the end-organs.

All man-made photographic instruments, except the panoramic camera, employ the flat screen. In the eye, the concave screen is utilized, which gives a wider angle of vision than that of any photographic instrument. In the case of birds, in which the eyes are situated on the lateral planes of the head, the visual fields overlap behind. This is a protective function. In the case of man, the eyes have been withdrawn from the lateral to the frontal plane. This is for the benefit of binocular vision. Incidently, this removal has reduced the visual angle. The remnant, however, is considerable and serves us well during this, the era of the automobile. It has been said that there are two kinds of people—the quick and the dead, or, synonymously, those with and those without a visual angle. According to Starling, the visual angle of human beings is 104 degrees, which is considerably less than that of the birds, in some of which it is 208 degrees. But then the bird's need

is more for self-preservation and less for binocular vision; whereas man, except in his dealing with the automobile, needs less of the former and more of the latter.

Probably the greatest good resulting from the hollow contour of the eye lies in this greater angle of vision. A wide visual angle means a ready discernment of movement in objects situated well outside the line of vision. Moving the eye into the frontal plane has materially reduced the angle of the nasal field, owing to the encroachment of the nose. It is interesting to note the economy which nature shows in dealing with this encroachment; for she does not extend the rods as far forward on the temporal side of the retina, as she does on the nasal.

The radius of the curvature of the eyeball, as made up by the sclerotic, is roughly minus 11 mm.; the radius of curvature of the cornea is minus 7 mm. This placement of the highly curved meniscus on the front of the eye, where it can be unshielded by encroaching parts, increases its light-gathering power. The curvature of the cornea is greatest at its central optical zone; there, in the normal eye, the curvature is almost spherical. This spherical area extends horizontally about 4 mm. and less than this vertically. It is decentered outward and a little downward. The parts of the cornea peripheral to the spherical central area are considerably flattened, which reduces the convergent effect produced in light incident over these areas. However, owing to the fact that the cornea overrides the lens at its periphery, the light that is incident on the cornea in its extreme periphery is directed toward the lens. Owing to the commonly small size of the pupil, all the light directed by the cornea on the lens must enter it through the umbo.

In tracing such a ray, which arises as an oblique centric pencil, one finds it passing into the lens through the first nodal point and coming out of the lens from the second nodal point, in a direction parallel to the ray incident through the first nodal point. Figure 1 illustrates this point better.

According to the definition of the nodal points, ray CP, incident on the anterior surface of the lens XY, in a direction which, if prolonged would extend through the first nodal point N^1, will be refracted at the point Q as if the refracted ray had arisen from the point N^2, which is the second nodal point. The plane of the refracted ray is parallel to the plane of the incident ray. The differential in the refractive indexes peculiar to the media on the two sides of the lens modifies this statement somewhat. It is this ability of the eye to collect light coming to it from wide angles and to direct this light through the lens and to the sensitive retina which makes possible the wide angle of vision peculiar to the eye.

Here, again, it is apparent that the sensitive retina, if situated in a plane, instead of a hollow sphere, would be much less effective in dealing with these rays emanating from a wide-angled source. On a flat retina, many more sensitive retinal elements would have to be provided, making the back of the eye much larger and out of all proportion to the focusing mechanism. Otherwise, the sensitive retinal elements would not be far enough out of the visual axis to accommodate the divergence occurring after refraction of these oblique centric rays. Too, such an arrangement of the sensitive elements in the plane of the

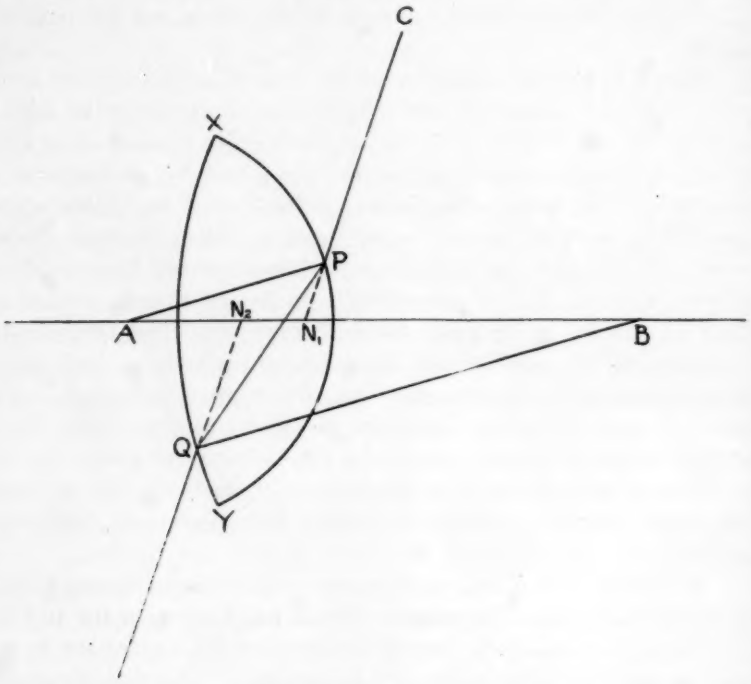

Fig. 1.—Nodal points of a thick lens of the convergent type encountered in the eye.

second principal focus would produce larger circles of diffusion on the retina—a fault largely overcome by bringing forward the part of the retina on which fall these oblique centric rays. It is a peculiarity of oblique centric pencils that the images which they form are closer to the lens than the site of the principal focus. The lens has, as it were, more refractive power for oblique centric pencils than for axial centric pencils. It is because of this peculiarity of oblique centric pencils plus the need placed on the eye to obtain wide-angled vision, in order to protect the individual against the damaging approach of a tumultuous

environment, that nature has moved the periphery of the retina forward better to handle these pencils.

The concave interior of the eye affords other advantages which the man-made camera could well take advantage of where it possible to stretch smoothly the sensitized film over the interior of such a concave arrangement. For instance, the concave retina, by the approximation of its periphery toward the lens margins, lessens the discrepancy between the plane of the retina and the caustic curves resulting when images are formed by eccentric axial pencils. The extremities of the image formed by pencils of light eccentric to the axis are closer to the lens than the principal focus. In other words, the images corresponding to the extremities of an object are closer to the lens than are the images of the object increments which are closer to or on the principal axis. The result is a curvature of the image in the same direction as

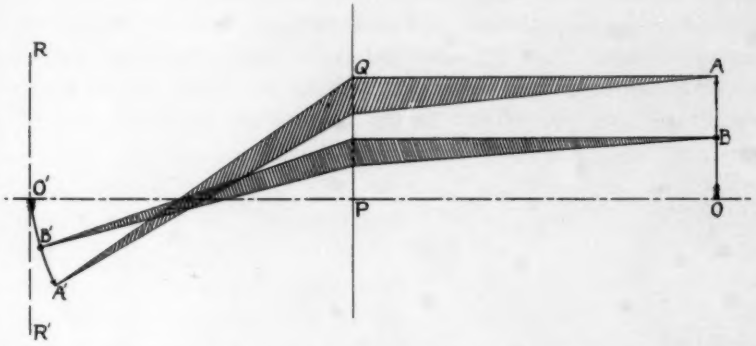

Fig. 2.—Curvature and distortion of real image formed by convergent lens when aperture is large.

the concavity of the retinal cup. If the retina occupied the plane RR' instead of the curve RA' (fig. 2) the retina would be much farther from the site of the image A' and the consequent circles of diffusion would be much larger. It is probable here, too, that perception helps to coordinate properly a distinct image increment on the axis with an indistinct one on the periphery. To accomplish this, accommodations may have to make separate and distinct efforts. Then, by a combination of the image obtained by this special accommodative effort with the memory image gained by corresponding effort for the other image increments, the whole image is integrated.

In dealing with the vagus image increments the discernment of which is essential to the comprehension of an object of interest, not only does the accommodation need frequent change, but the eyeball itself must rotate to bring these vague images on to the fovea for closer scrutiny. This movement can be better accomplished through

the agency of a readily movable spherical eye. It is by combining memory images and giving them the proper spatial relationship after they have been carefully scrutinized by the fovea, that accurate visual concepts are formed. This process requires frequent accommodative change and directional adjustment by the extrinsic eye muscles.

SUMMARY

A spherical eye, then, is a more workable eye because: It brings the peripheral retina forward, better to receive, without blurring, the images formed by excentric parallel pencils that focus in a plane closer to the lens than the principal focus. Also the spherical contour better enables the eye to handle oblique centric pencils. The latter, too, form images in a plane that is closer to the lens than the principal focus. The images that fall on the retina are necessarily curved because of the position of the various increments that go to make it up. The hollow spherical contour of the retina better complies with the shape of the composite image. Also the spherical shape better facilitates the movements and adjustments of the eye within the orbit as more careful scrutinization of the various image increments is carried on by the fovea.

CONSEQUENCES OF SOFTENING OF THE EYEBALL *

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The eye may become soft either suddenly after perforation, with escape of contents, or slowly, as after detachment of the retina or in atrophy of the eyeball. The sequelae are somewhat different in these two cases. I shall discuss them according to the membranes which constitute the eyeball.

The fibrous envelop of the eye—sclera and cornea—contracts uniformly in young persons without wrinkling to such a degree, when the loss of content is not great, that the eye retains its shape, being only slightly diminished in size. This adaptation is facilitated by partial compensation of the loss of content through an increased filling of the intrinsic vessels, especially of the choroid. In the eyes of old people the intrinsic vessels also dilate after sudden softening, but the contraction of the fibrous membranes is often insufficient if the loss of content is considerable. Then the cornea folds, due to acute softening, especially at its posterior surface, where folds appear at clinical examination as delicate gray lines, termed keratitis striata. These folds are best visible after extraction of the cataract as striae perpendicular to the incision, and after perforation of an ulcer when the striae exhibit a radiating or netlike arrangement around the fistula. Folds form at the anterior surface of the cornea only if the softening of the eye is considerable.

If much of the content of the eye empties, as for instance at an extraction of a cataract, when not only the aqueous humor and the lens but also a part of the vitreous body escape, the cornea is pressed in by the pressure of the air-collapsus corneae. If the pressed in cornea tends to resume its normal curvature, it makes the aqueous chamber fill with air by suction.

The change of the shape of the sclera usually escapes observation so far as its posterior part is concerned, because it is not exposed in the palpebral fissure. The sclera is flattened or even pressed in by the action, posteriorly, of the extrinsic muscles of the eye, especially of the four recti muscles. These form an arc in their course between the equator and their insertion at the sclera, which the normal tonus of the muscles tries to flatten, even if there is no active contraction of the

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muscles. In this way a soft eyeball is flattened in its anterior part at its four sides, or in higher degrees of softening takes on a square shape or is even pressed in so as to assume the shape of a bale.

Owing to the natural tonus, the four recti pull the eyeball back toward the orbital fat and the optic nerve. As these are incompressible, they flatten or even press in the posterior part of the eyeball. I was able to observe this once in a highly myopic eye after extraction of the cataract. In this case the ophthalmoscope showed the bulging of the posterior part of the fundus into the vitreous body, the protrusion being facilitated by the fact that, because of the high myopia, the thickness and resistance of the sclera were much reduced at the posterior pole of the eye. Without doubt such changes of the shape of the eye are more frequent than is generally admitted, but they remain unnoticed, because they can be observed only if the eye is examined with the ophthalmoscope shortly after the perforation, for instance, immediately after the operation for cataract. However, one does not like to make an immediate examination for fear of damaging the eye, and an examination at a later date does not show the protrusion of the fundus, as it disappears in the same measure as the eye resumes its normal filling by the restitution of the lost content, which usually takes very little time.

In cases of chronic softening, for instance, in atrophy, the eye remains smaller forever, and permanent folds develop in the cornea and sclera. The cornea becames smaller with a corresponding increase of thickness. Folds of Descemet's membrane and sometimes also small folds of Bowman's membrane reveal themselves as gray lines, because between the membranes mentioned and the stroma of the cornea the tissue is under lower pressure, which leads at first to accumulation of lymphocytes and later to new formation of connective tissue at these places. Contrary to this, a very small cornea may exceptionally have preserved its normal thickness and transparency. The sclera not only remains flattened at the four sides, but also develops a permanent fold behind the insertion of the four recti muscles extending all round, so that it looks like an invagination of the sclera.

The iris is displaced either forward or backward, according to the degree of diminution of aqueous or vitreous humor. In the latter case the iris sometimes forms a circular shape at its periphery. From its insertion it retains at first its normal position, then, corresponding to the summits of the ciliary processes, bends abruptly backward at a right angle, and shortly afterward bends again under a right angle, so as to lie in a plane parallel to the normal plane but somewhat posterior to it. Ordinarily in cases of iris retraction the most peripheral portion of the iris is not involved, such involvement being prevented by the ciliary processes lying immediately behind it. This kind of circular step is to be found only in eyes having a lens,

not in aphakic eyes in which the iris after successful cataract operation lies in one plane throughout its full extent. Even if no posterior synechiae exist, the lens pulls back the iris which is adherent to the lens just as two smooth wet surfaces adhere to each other. The periphery of the iris, however, is kept back in its normal position by the ciliary processes, and it is only beyond these summits that the iris is allowed to follow the pull of the lens by bending abruptly backward. A shrunken lens having a very uneven surface does not draw the iris along. If the eye softens suddenly as after perforation, the vessels of the iris become engorged and may rupture, so that the aqueous chamber fills with blood. In such cases also the vessels of the ciliary body are engorged and allow blood plasma to escape into the posterior chamber. By this, as Greeff found in the eyes of rabbits, the epithelium of the processes becomes detached, forming small vesicles. In human eyes, however, this occurrence is exceptional when the escape of the intra-ocular liquids is excessive. The different behavior of the human and the rabbit's eye is due to the fact that in proportion to the size of the eye the aqueous chamber of the rabbit is much larger than that of the human eye, and therefore the escape of the aqueous humor of a rabbit's eye causes a much higher degree of softening than in man.

Also in the choroid, the diminution of the intra-ocular pressure is followed by hyperemia of the vessels with considerable increase in the thickness of the choroid, which frequently becomes detached from the sclera, the space between the two membranes being filled with a serous liquid. This form of detachment of the choroid was believed to be very rare until I stated that it is quite frequent after the escape of aqueous humor and still more frequent if the lens or some of the vitreous body also escapes. For this reason detachment of the choroid occurs often after such operations as iridectomy, extraction of the cataract and, most of all, after trephining. It is also frequent after perforation by an ulcer or an injury, but in these cases, as a rule, the media of the eye are not sufficiently transparent to allow of an ophthalmoscopic examination. The presence of a detachment becomes evident only if such eyes have to be enucleated for anatomic examination.

The best opportunity to observe detachment of the choroid with the ophthalmoscope is afforded by the aforementioned operations, if the anterior chamber is late in reforming, or, if reestablished, empties again. Such cases must be examined as soon as possible after the operation, because after reestablishment of the aqueous chamber the detachment disappears rapidly without leaving any trace. Seen with the ophthalmoscope, the detached choroid appears as a dark projection with a smooth surface, which does not make undulating movements like a detached retina and over which the retinal vessels pass without tortuosity. In the lightest cases the detachment involves only the foremost part of the

choroid, so that it is difficult to observe. In other cases the detachment may be so extensive that the choroid is pushed into the vitreous cavity nearly as far as the sagittal axis of the eye, so that it becomes visible even with focal illumination as a brown round prominence.

The detachment usually occupies the temporal or nasal side and often both sides at the same time; it is rare above and below and is never found at the posterior pole, because here the choroid is bound down to the sclera.

In order to understand the pathogenesis of the detachment of the choroid, one must remember that in a softened eye, the sclera is flattened or pressed in. It then behaves like a compressed rubber ball, attempting to resume its normal spherical shape. This has a sucking effect and causes serum to transude from the vessels of the choroid, filling the space between the sclera and choroid, because no vacuum can exist within the eye.

The congestion of the vessels of the retina and choroid after a sudden drop of the intra-ocular tension is often followed by hemorrhages. These are rare and small within the choroid, but frequent and often massive between the choroid and sclera, as is easily understood because of the suction effected by the sclera. The highest degree of bleeding occurs if a ciliary artery, especially one of the two long posterior ones, ruptures. Then the blood leaves the artery under arterial pressure, pushing the choroid more and more into the vitreous body, until eventually the intra-ocular pressure has risen to the level of the arterial pressure and stops the bleeding by tamponade. Such a subchoroidal hemorrhage is the cause of most of the cases of so-called malignant glaucoma, in which the glaucomatous eye remains hard or even becomes harder after a decompression operation. This event may be guessed at, if, during the operation, or immediately afterward, quite suddenly the patient is seized with intense pain, the incision gapes and the eye feels hard. Only in the lightest of such cases may the eye recover by absorption of the hemorrhage. In most cases the tension remains high and the eye becomes blind. In some cases this event takes place during, or immediately after, the operation, if the hemorrhage is so massive as to press the contents out of the eye by expulsive hemorrhage.

In the case of sudden escape of aqueous or vitreous humor, the lens is displaced brusquely forward or backward. By this the suspensory ligament may be torn, so that a subluxation or a luxation of the lens ensues. Later the lens usually opacifies, especially if its capsule has been ruptured during the dislocation.

It is generally believed that the escape of a considerable quantity of aqueous and vitreous humor is easily followed by a detachment of the retina. In numerous cases in which I have operated the liquefied vitreous body escaped to such an extent that the eye collapsed, but a detachment of the retina never developed. Also the removal of the vitreous body

by suction for therapeutic purposes, after Zur Nedden, does not cause detachment of the retina. Under these circumstances a detachment of the choroid is more likely to occur, not simultaneously with the escape of the vitreous body, but slowly and in the same measure as the serum transuding from the choroidal vessels fills the space between the sclera and the choroid. Why is it that in these cases the choroid detaches itself from the sclera and not the retina from the choroid? According to my conception, it is because two smooth and humid surfaces in closest contact, as those of the retina and choroid, oppose a considerable resistance to separation, while between the sclera and choroid are interposed the lamellae of the suprachoroidal membrane, which separate most easily as one sees in so many specimens, so that a detachment of the choroid from the sclera does not meet with any noteworthy resistance. Detachment of the retina is more to be feared if the normal vitreous body escapes, because it is fixed at the ciliary part of the retina, which it might detach from the ora serrata. But a normal vitreous body never flows out of the eye to any considerable amount, because it does not flow at all, being a gelatin. It can only be expelled from the eye, as occurs so frequently after contusion with rupture of the sclera. In most of these cases a detachment of the retina accompanies the escape of the vitreous body.

Another sequela to a sudden softening of the eyeball, to which hitherto no attention has been paid, is the gliding of the retina on the choroid. By the contraction of the sclera its inner surface is somewhat reduced and the choroid keeps pace with it also by contraction, but not the retina, which is less contractile. Consequently, small folds form in the retina, involving mostly only its external layers. In some cases the folds may persist after reestablishment of the normal tension, but usually they disappear, leaving behind defects in the neuro-epithelium, which, however, are too small to interfere seriously with vision.

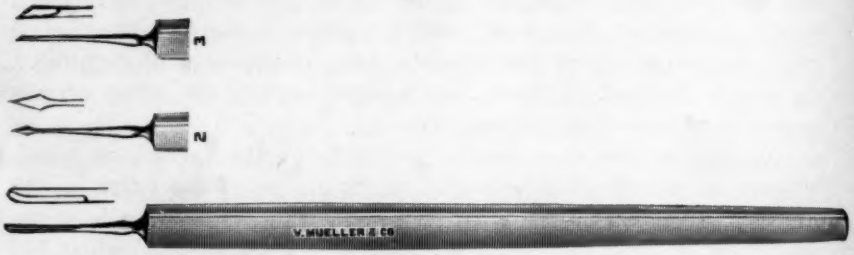
The papilla of the optic nerve exhibits an edematous swelling similar to choked disk in many cases of softening of the eye, acute as well as chronic. Owing to this edema of the optic nerve head, not infrequently a glaucomatous cupping disappears during the days after a decompressing operation. But this phenomenon is not due to the lamina cribrosa resuming its normal position, but to the edematous swelling of the tissue still left in front of the lamina. When the intra-ocular pressure has gone back to its normal level, the edema of the papilla disappears and the previous cupping again becomes visible. The edema of the papilla is due to an alteration of the relation between intra-ocular and intracranial pressure. Normally the first is considerably higher than the latter, for which reason the lymph current goes along the optic nerve from the eye to the cranial cavity. If the intra-ocular pressure has gone down to zero, the lymph accumulates in the head of the optic nerve, no longer being able to pass into the cranial cavity.

CORNEAL SPUDS*

FRED J. WALTER, M.D.
SAN DIEGO, CALIF.

The need of smaller corneal spuds has doubtless long been obvious to many general practitioners and ophthalmologists doing industrial work. The accompanying illustration shows the actual size with enlarged detail, and also shows the construction of the operating end perfectly.

Very minute bodies embedded near the center of the cornea, if not carefully removed, will leave scars and much unnecessary astigmatism. Very often I have found the standard spuds to be many times larger than the particles embedded. I therefore have devised a set of three



Corneal spuds.

spuds with 0.5 mm. shanks: (1) a very sharp and grooved spud to go easily beneath bodies that may be burned in, (2) a familiar arrow-pointed end for general use and (3) bias at the point for use as an operating knife or pry to dislodge minute bodies without the mutilation of a particle of tissue.

4381 Hart Drive.

* Submitted for publication, Jan. 20, 1930.

LENTICONUS POSTERIOR

REPORT OF SIX CASES *

T. HARRISON BUTLER

BIRMINGHAM, ENGLAND

Dr. Henry H. Tyson published in the ARCHIVES OF OPHTHALMOLOGY [1] the report of a case of lenticonus posterior. He pointed out that the abnormality was of extreme rarity, only six of the hitherto published examples having stood the test of slit-lamp examination. Fuchs, in his textbook, stated that lenticonus posterior is not so uncommon as lenticonus anterior, but he had seen only three cases.

The condition cannot be so rare as is supposed. Miss Mann said that she had seen three cases in London. Mr. P. J. Hay informed me that three or four examples had been shown to the Northern Ophthalmological Society of England, of which he is secretary.

The number of published cases of any abnormality is no criterion of the actual incidence of this condition. The majority of ophthalmologists do not publish their interesting cases, and not all have the necessary knowledge to differentiate a lenticonus from a posterior polar cataract. When, as in three of my cases, the alteration in the curvature of the posterior surface of the lens is associated with a definite opacity, it is necessary to have considerable experience in the technic of the slit-lamp to recognize the true state of affairs, Glasses had been ordered for one of my patients at a school clinic, and the typical lenticonus had not been recognized. Probably in the majority of cases the condition is not diagnosed.

I have tried to form some idea of the actual incidence by an analysis of the number of patients with whom I have been associated.

During the four years that I spent at the British Ophthalmic Hospital in Jerusalem, my colleague, Dr. W. E. Cant, and I examined and treated about 25,000 patients. I did not recognize a single case, but only a fraction of the number was examined with the ophthalmoscope, and at that time had one passed through my hands I probably had not sufficient knowledge to diagnose it.

During the past twenty-two years, I have seen more than 30,000 patients at the eye department of the Coventry Hospital. The majority have been examined with the ophtalmoscope, and not one case of lenticonus has been diagnosed.

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* Submitted for publication, Jan. 6, 1930

1. Tyson, H. H.: Lenticonus Posterior, with Report of Case Studied with the Slit-Lamp with 2 Drawings, Arch. Ophth. **57**:38 (Jan.) 1928.

I have performed refraction on 13,000 children at the Coventry School Clinic, and this year I found a case.

During twenty years work at the eye department of the Warneford Hospital, Leamington, I have examined 10,500 patients, most of them with the ophthalmoscope. In 1929, one case was detected.

During the past seventeen years, I have been on the staff of the Birmingham Eye Hospital; 320,000 patients have been treated by my colleagues and me, and two cases have occurred, both in 1929. Here again only a proportion have been examined with the ophthalmoscope.

During twenty-three years of private practice, I have not seen a single case.

To sum up, two typical and three atypical cases have occurred among about 500,000 patients. This means only that the actual incidence is not less that 1 in 100,000, but it is probably very much more, perhaps four times as great.

The two typical cases were recognized with the ophthalmoscope, and the diagnosis was confirmed with the slit-lamp. The atypical examples in which the lenticonus was associated with an opacity were diagnosed with the slit-lamp and could not have been diagnosed without it.

My first introduction to lenticonus was at Professor Vogt's slit-lamp course at Zürich, where we were shown a typical case. Since then I have kept a keen watch for further examples, and have succeeded in gathering the five which form the subject of this paper. Unfortunately, I cannot command the services of an artist trained in ophthalmic work, and have been compelled to make my own illustrations. It is possible that what is lost in artistic merit may be regained in accuracy.

REPORT OF CASES

CASE 1.—Kathleen Reed, aged 9, came to the Coventry School Clinic on Jan. 9, 1929. Her vision with undilated pupils was: right eye, 6/36; left eye, 6/6. When the right eye was examined with the plane mirror for retinoscopy, with the pupil dilated, a sharp-edged opacity was noticed in the center of the field of vision. With a +20 lens behind the electric ophthalmoscope, a highly refractile globe like a glass ball was seen in the posterior region of the lens. As the light was thrown now this way, now that, a crimson, flamelike reflex played around the edge of the structure, which careful focusing showed to be a deep basin-like depression in the posterior surface of the lens. A halo of light was seen on the retina close to that side of the basin on which the light was thrown. The depression had everywhere a sharp, narrow, brightly illuminated edge, and did not shelve away gradually like the specimen I saw at Zürich. The appearance seen with the ophthalmoscope is shown in figure 1.

Examination with the slit-lamp and objective Ao, a magnification of 15, showed that the anterior part of the lens was normal. All the usual architecture was clearly seen, including the central lenslike embryonic nucleus and both anterior and posterior Y's. The posterior surface of the lens showed the characteristic

bulge. At its apex was a slight area of condensation, hardly an opacity, probably representing the arc line, and hanging from it into the retrolental space was a perfect remnant of the hyaloid artery, the appearance seen in most children at 9 years of age. Immediately in front of the conus there was a line of condensation following the curvature of the posterior curve, and between the two there was a horizontal line of faint opacity. Faint lines of condensation following the same curve were placed between the posterior curve and the anterior line of condensation. The slit-lamp picture is shown in figure 2.

Retinoscopy of the peripheral part of the lens gave 3 diopters of hypermetropia in the vertical meridian and 4 in the horizontal. With the use of atropine, the right eye, with a +4 diopter sphere and a +1 diopter cylinder, axis vertical, gave an acuity of 6/24.

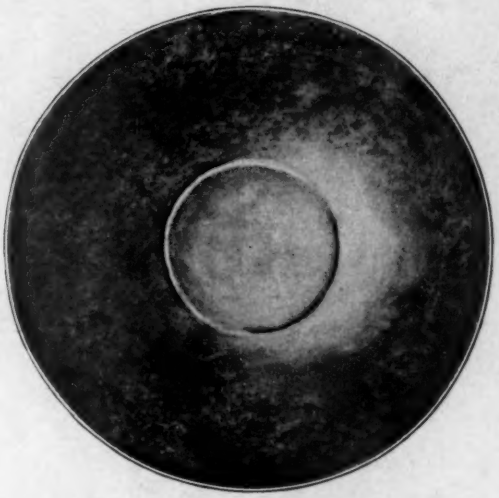

Fig. 1.—View with the ophthalmoscope with +20 behind the mirror. The light is thrown from the left. The dark lines around the central sphere represent the crimson flamelike reflex. On the right of the globe is seen the glow on the retina. (Owing to the great cost of color printing, the original drawings in color have been reproduced in monochrome, and in consequence some of the features seen in the originals are not quite obvious in the diagrams printed.)

CASE 2.—Miss Packwood, aged 26, came to the Birmingham Eye Hospital on April 19, 1929, under the charge of Mr. J. Jameson Evans, asking for glasses. She had had some ordered at school.

When examined by retinoscopy with a dilated pupil, a small circular opacity was seen in the field of view occupying about one eighth of the total area seen with a plane mirror. With a +20 lens behind the ophthalmoscope mirror, the opacity was seen to consist of two very bright concentric rings. The outer ring was surrounded by a halo darker than the general tint of the retina. The area within the inner ring could not be examined in any detail as it gave a perfect reflection of the filament of the electric ophthalmoscope. The ophthalmoscopic

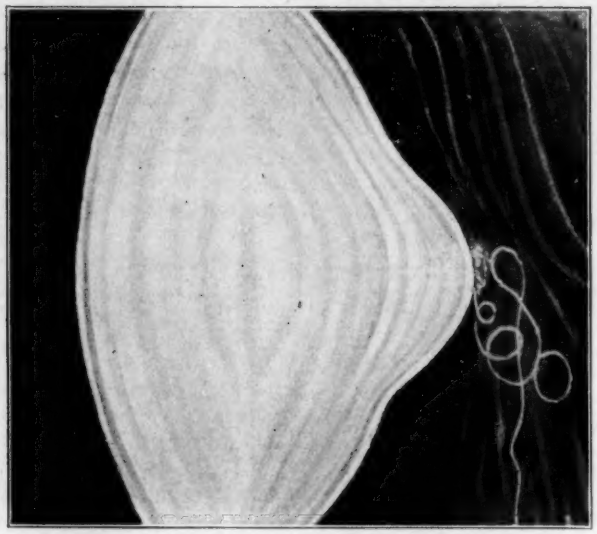

Fig. 2.—The same lens as in figure 1, seen in optical section with the slit-lamp. The posterior bulge, the concentric condensation lines and the posterior opacity are evident. The horizontal condensation line, representing the collar-stud formation, is difficult to make out. The remnant of the hyaloid artery is seen hanging into the retrolental space. It is unusually convoluted.

Fig. 3.—The central abnormality is seen surrounded by a bright ring. The central area reflected the image of the filament, and shone brilliantly.

picture is seen in figure 3. Examination with the narrow beam of the slit-lamp showed a small sharp bulge in the posterior surface of the lens. The conus was much smaller than that seen in case 1. In front of the conus the subcapsular line showed a contour nearly concentric with the conus but not quite so curved. Between this line and the surface of the infantile nucleus was an axially lying structure like a collar-stud. The anterior part of the lens was normal in all respects. Both anterior and posterior Y's were well seen and were normal.

The appearance with the broad beam is very difficult to draw, but I have tried to represent it in figure 5. The anterior part of the collar stud has a four-leaved rosette shape. The posterior part is discoid and both are united by a sharply defined stem. No hyaloid artery was detected in this case, but such are unusual at the age of 26. The acuity of the eye with a + 0.5 diopter sphere and + 1.5

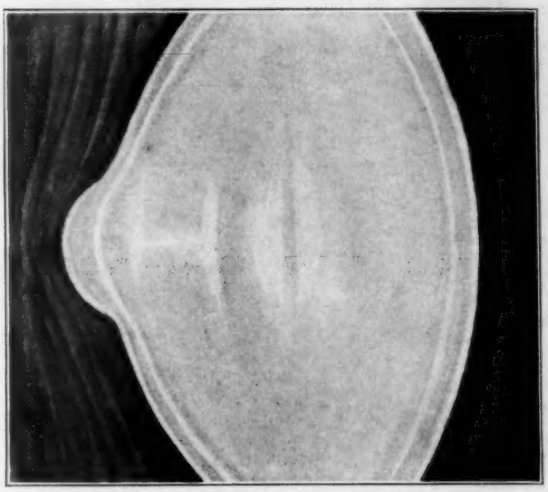

Fig. 4.—The same lens as in figure 3, seen in optical section. The collar-stud formation is clearly seen.

cylinder at 75 degrees was 6/18. There was no difficulty in carrying out a retinoscopy in the peripheral part of the lens. No crimson flashes were seen around the periphery of the basin.

In both these cases the abnormality was not confined to the capsule. The lines of discontinuity in front of the capsule showed a backward bulge almost concentric with the conus, and in each there was an axial opacity which in case 2 presented a peculiar structure. Tyson mentioned the same condition. "An addition feature of the case was an irregular conical opacity situated axially between the embryonal nucleus and the normal position of the posterior pole. Broad and flat anteriorly, it had an irregular posterior taper, to end like a trumpet-mouth at about the normal curve of the posterior surface." A similar opacity was described by Vogt in his atlas.

CASE 3.—Miss Smith, aged 45, came to the Warneford Hospital, Leamington, on May 30, 1929, complaining of defective acuity in the right eye. Vision was: right eye, 6/60; left eye, 6/4.5. The vision of the right eye could not be improved by glasses. Retinoscopy was impossible.

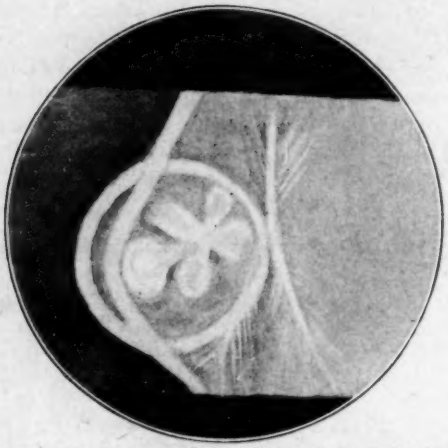

Fig. 5.—White roset on the posterior surface of the infantile nucleus, connected to a posterior disk like a collar-stud.

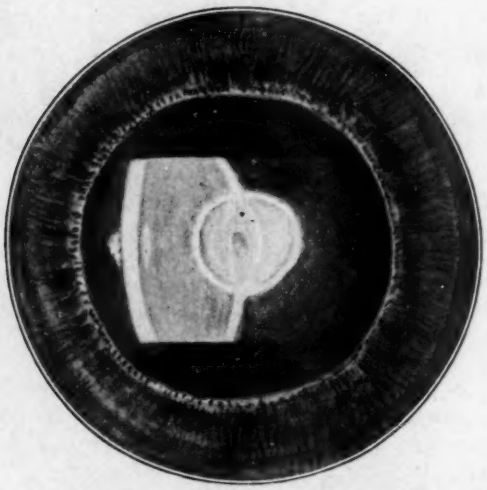

Fig. 6.—The lens seen with the broad beam of the slit-lamp.

Examination with a plane mirror showed a slight general haze of the lens and a central white opacity deep in the lens; there was also a small opacity superficial in the lens. Examination with +20 diopter lens behind the mirror of a Lister electric ophthalmoscope showed that there was a small white opacity situated centrally in the region of the anterior capsule. Deep in the lens there

was a somewhat irregular circular opacity of a yellowish hue. Toward the center of the main opacity there was a small dense opacity. Careful focusing revealed the fact that the opacity was basin-shaped. The edge of the conus did not gradually shelve, but appeared to be sharp and tucked over inward. In front of the main opacity, there were a few diffuse opacities in the posterior cortex.

Examination with the narrow beam of the slit-lamp localized the anterior opacity just under the subcapsular line. The capsule itself was normal and free from any trace of opacity. The subcapsular line was sharp and did not show any lack of transparency. The central part of the lens was normal, showing the usual lines of discontinuity. Starting from the edge of the posterior opacity, the line of the posterior capsule curved backward in a regular line, showing exactly the same conus as was seen in cases 1 and 2. There was no doubt that this case was one of lenticonus posterior associated with a considerable degree of opacity. There was no axial opacity, only the diffuse opacities mentioned.

It is interesting to note that these three cases were all seen during 1929.

Fig. 7.—View with loupe of the lenticonus perinuclearis posterior or lenticonus internum. (Supplied by Oxford University Press.)

Case 4.—Mrs. Jenkins, aged 28, came to the Birmingham Eye Hospital in 1926, and was under the care of Mr. Jameson Evans. The acuity in each eye was less than 6/60. Examination of each eye with a loupe and the light from a half-watt bulb showed an oval, dense white opacity deep in the lens. The opacity had a smooth, apparently rounded border and a depressed center. From its periphery dense white striae radiated to the periphery. The fundi were seen with great difficulty. The appearance is shown in figure 7. So far both eyes seemed to be alike, but examination with the slit-lamp revealed a notable difference, and so I have classed them as two examples.

The dense opacity of the right eye made it difficult to trace the contour of the posterior capsule, but when I used a low magnification, F 55 objective, enlarging to 9 diameters, the posterior capsule was found to have the typical backward bulge of lenticonus posterior.

The periphery of the depression showed a double contour, and the edge was rounded off like the edge of a basin. The floor was stippled, and only with difficulty could anything be seen through it. Radiating from the periphery, opaque striae

spread into the surrounding lens substance. There was an anterior opacity under the anterior capsule involving the subcapsular line. The central part of the lens was clear and homogeneous. Figure 8 illustrates the appearance of the lens as seen under the broad beam of the slit-lamp. The picture of such a lens seen with the broad beam is exceedingly difficult to draw, and a skilled artist alone could do it justice.

CASE 5.—In the left eye of the patient whose condition in the right eye has been reported in case 4, the slit-lamp revealed a structure entirely different from that seen in the right eye.

The anterior opacity was similar, but the posterior basin-like depression did not appear to reach the posterior capsule. The contour line of the capsule could not be seen behind the opacity, which was much denser than that in the right eye, but as far as one could judge, it was perfectly normal. With the narrow beam,

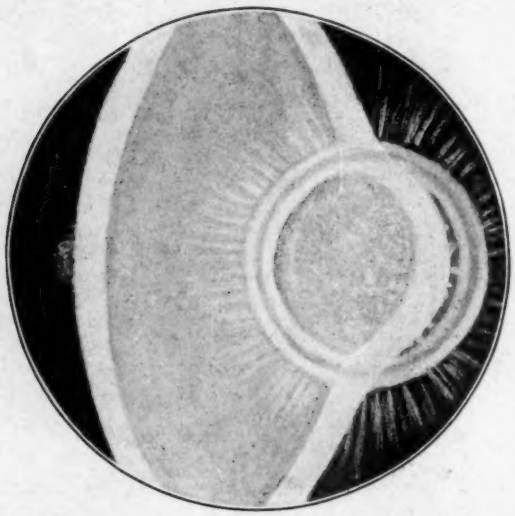

Fig. 8.—Large basin-like depression on the posterior capsule and cortex. The posterior surface of the lens shows the typical protuberance in contradistinction to the left eye, in which the posterior capsule appears to have a normal curvature.

a white line situated well in front of the capsule indicated the shape of the opacity. This passed backward in a sharp curve and then bulged forward, showing that the center of the conus bulged forward. This appearance is shown in figure 9. Figure 10 gives a schematic reconstruction of the lens. The central depression had a yellowish hue, and from its periphery there was a striated filmy layer of opacity spreading forward fanwise and becoming more and more superficial toward the periphery.

The report of this case was published in my "Illustrated Guide to the Slit-Lamp."

Mr. Jameson Evans made an attempt to remove the left lens in its capsule, but unfortunately the capsule burst, and there was nothing for microscopic examination. At the time of writing, the acuity was good, but another discission will be necessary.

Fig. 9.—Slit-lamp view. There is a superficial filmy layer of opacity spreading from the deep-seated cup forward fanwise, becoming more and more superficial at the periphery. A basin-like cup with smooth edges is seen. The cup is filled with a filmy jelly-like material. Apparently, the posterior capsule has a normal contour. (Supplied by Oxford University Press.)

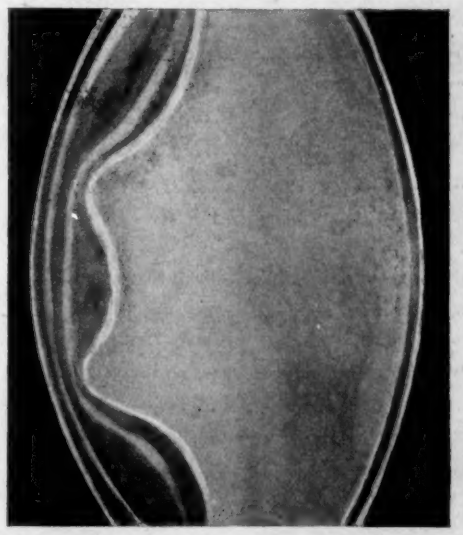

Fig. 10.—Reconstruction of the lens, semidiagrammatic. The lens substance is perfectly homogeneous in front of the opacity. There is an anterior opacity, as shown under the anterior capsule. (Supplied by Oxford University Press.)

Because the lenticonus in case 5 did not reach the posterior capsule, I called it lenticonus perinuclearis posterior. Another term would be lenticonus internum.

These five cases have been exhibited to the members of the Midland Ophthalmological Society; most of them are still available, and I shall be delighted to demonstrate them to anyone who cares to see them.

After this paper was submitted for publication, another case has appeared which is of extreme interest.

CASE 6.—Jack Jenkins, aged 11, is the son of Mrs. Jenkins (case 4). At the back of each lens there was a dense white opacity exactly like those present in his mother's eyes. The posterior surface of the lens, as far as could be seen, was of normal curvature; if there was a lenticonus posterior it was very small and hidden behind the dense opacity.

Seen with the narrow beam, the opacity was found to be confined to the posterior cortex of the lens and to be saucer-shaped, the convexity being directed backward. There was a definite suggestion of lenticonus posterior internum, as seen in one of his mother's eyes. There was a faint opacity just under the anterior capsule, again resembling the mother's eye. There was no "collar stud" formation.

The acuity of each eye was 6/24.

The interest of the case lies in the knowledge that in some cases lenticonus posterior may be hereditary.

COMMENT

It appears from the foregoing descriptions that certain points hitherto not stressed in the literature deserve further consideration. One is the fairly frequent occurrence (also noted by Dr. Tyson) of a "collar stud" opacity in the conus, another is the possibility of a lenticonus internum, as observed in case 5, while the fact that in only one was a marked hyaloid remnant present, should also be discussed.

In writing what follows concerning theories of development of the anomaly, I have freely consulted Miss Mann, and she concurs in the views set forth.

It is as well to say at the outset that no satisfactory embryologic explanation is forthcoming. This is not surprising in view of the well recognized fact that only a very few abnormalities can ever be explained by normal embryology. Most of them are pure aberrations; only a few are pure arrests, while some are explicable as arrests with superimposed aberrations. In most cases all that can be done is to determine approximately the time at which the aberrance began. In the present series of cases the condition is a pure aberrance and cannot, I feel sure, be explained by an appeal to normal development.

One can attempt to determine the time which the lenticonus began from its situation; that is to say, since it occurs in the layers superficial to the Y suture, it is outside the fetal nucleus and so arises in connection

with lens fibers formed relatively late, probably during the sixth or seventh month or even later. A good deal of the bulge must even be formed after birth.

With regard to the occurrence of a "collar stud" or reduplication opacity in the bulge in some of the cases, I feel that this opacity is extremely interesting and might, if studied more fully, yield some working theory of origin. It is interesting that in all the cases described in this paper it differs from the usual anterior "Kalk" in that the more superficial part of the "Kalk" is not in contact with the capsule but is separated from it by clear cortex. This makes its formation harder to understand, as it scarcely seems likely that it is produced by interference with the capsule, as is the anterior one. Unless one examined especially

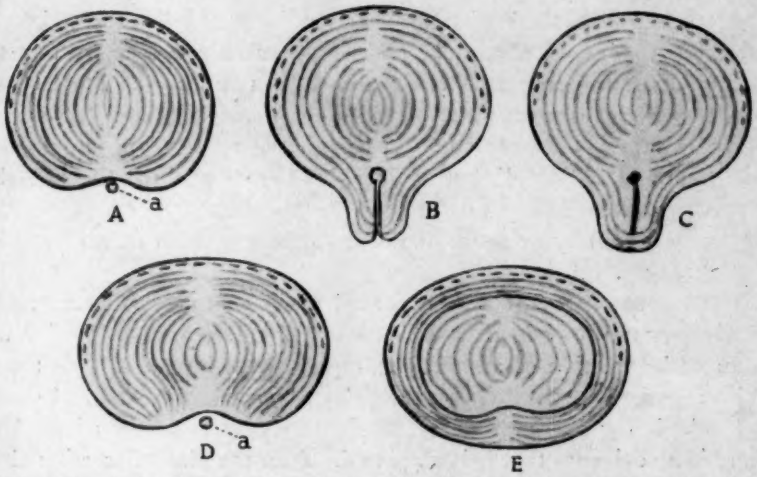

Fig. 11.—*A*, the lens being partly invaginated behind by an artery (*a*). *B*, the artery has passed inside the lens. *C*, the artery has separated off from the external surface, forming the "collar stud." *D*, a lens at 40 mm., being invaginated by an artery (*a*). *E*, the lens at 7 months. The artery has now disappeared, leaving the beginning of a lenticonus internum. Compare with figure 10.

for this, it might be possible to miss a corresponding opacity on the capsule. In case 1 there is an opacity on the capsule which is suggested to be the arc line, but which may be part of the "Kalk."

If one wishes to frame an attractive theory linking the "Kalk" with an aberrance of the hyaloid or of a vessel of the posterior vascular lens capsule, one can postulate an abnormal inclusion of a fold of capsule and a vessel between the lips of a suture.

A reference to figure 51, page 60, in Miss Mann's book on the development of the human eye will show a lens with a depression behind corresponding to the forming suture. If a vessel kept the capsule pushed in here abnormally long, the lens fibers could not meet, and so might elongate and form a bulge (fig. 11, *A*, *B*, *C*).

Against the acceptance of this idea, however, there are the following difficulties: 1. The abnormality would be more likely to happen in the early stages, about 40 mm. (i. e., before the third month), when there are a good many vessels. In reality, it is late in appearing, when there are very few. 2. Nothing in the cases described looks the least bit like included mesoblast. 3. The opacity should have a connection with the surface. So one must, I think, abandon this theory as unproved. It is possible, of course, that it was not an extracapsular vessel which kept the fibers apart, but some abnormal material in the suture. It is known that abnormal material can be deposited in the sutures, e. g., suture cataracts. Against this is, of course, the fact that the "Kalk" is not the shape of the suture, though this is not essential if only a part were affected.

With regard to the lenticonus internum in case 5, this also might be accounted for by an abnormal inclusion occurring earlier than in the others and lasting only a short time, so that ultimately all trace of the transitory disturbance became buried deep in the lens, and the normal surface contour was restored. This might be shown diagrammatically as in figure 11, *D* and *E*, but against this theory again is the fact that no trace of an inclusion can be seen in the adult. It is possible that deformity caused by pressure might produce it, without actual inclusion of the capsule.

Finally, the fact that a well marked hyaloid remnant was seen only once is very much against the older theory that lenticonus posterior was produced by traction of an abnormally persistent hyaloid. This theory is also negatived by the fact that the bulge if caused by the hyaloid should always be below and to the nasal side of the posterior pole of the lens. There is no evidence that it is so placed. Also the idea of traction alone as a cause is adequate to explain neither the shape produced nor the existence of a "collar stud" opacity.

It has also been suggested that abnormal thinness of the capsule at the posterior pole allows the lens to bulge here, apart from pressure or traction. There is no evidence in support of this, as the capsule can be seen with the slit-lamp and shows no thinning. Also there is no evidence that the capsule (which is itself formed by the lens fibers) ever exerts any pressure on the growing lens or accounts for its shape in normal development.

At present all the evidence appears negative, but it is in the hope that these considerations may serve as a stimulus to more accurate observation of cases that I venture to indulge in the discussion of it.

THE HISTOLOGIC BACKGROUND OF THE OCULAR SYNDROME IN BOTULISM *

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OMAHA

The incidence of botulinus intoxication is relatively low if one considers the frequency with which *Bacillus botulinus* is encountered in nature. It is doubtful if the condition ever occurs in man or in his domestic animals except through foods that have been preserved by man-made methods, although according to Meyer and Dubovsky [1] *Bacillus botulinus* is found in the soil of practically every section of the United States. The fact that it is found even in the soil of virgin mountain forests indicates how widespread is its existence. As the bacillus is an anaerobe, its activities in food poisoning are more or less restricted to foods that are preserved or cured by processes whereby all uncombined oxygen has been excluded. This applies to foods that are preserved by faulty canning methods, to animal forage preserved in silos and to fodder or grain that is seasoned in granaries and barns. It was believed at one time that the principal medium of botulinus poisoning was sausage. Van Ermengem,[2] who discovered the organism, subscribed to this belief, and accordingly chose its name from botulus, Latin for sausage.

Although botulinus intoxication is a comparatively rare disease, *The Journal of the American Medical Association* [3] stated that in the United States and Canada from 1899 to 1928, 165 outbreaks were recorded, with a total of 529 cases. Many of these cases lack authentication by bacteriologic and toxicologic tests. Nor is this unusual, as investigation is only too often rendered impossible owing to the fact that the suspected food has been thrown away or otherwise disposed of; in such instances, one must rely on the clinical evidence to establish the diagnosis.

The clinical picture of botulinus intoxication has been set forth by Van Ermengem [2] as follows:

> Secretory disorders of the gastro-intestinal tract; symmetrical motor paralysis, complete or partial, depending very likely on lesions of the medulla, especially of the nuclei of various cerebral nerves and of the anterior horns of the spinal cord. It is characterized:
>
> 1. by an arrest of secretion or by a hypersecretion of saliva and bucco-pharyngeal mucus;

* Submitted for publication, Feb. 12, 1930.

* Read before the Sioux Valley Eye and Ear Academy, Omaha, Nov. 19, 1929.

1. Meyer, K. F., and Dubovsky, Bertha J.: J. Infect. Dis. **31**:559, 1922.
2. Van Ermengem, E.: Arch. de pharmacod. **3**:213, 1897.
3. Special Article, The Frequency of Botulism, J. A. M. A. **90**:764 (March 10) 1928.

2. by more or less complete external and internal ophthalmoplegia (ptosis, mydriasis, paralysis of accommodation, diplopia, internal strabismus);

3. by dysphagia, aphonia, obstinate constipation and retention of urine;

4. by a general weakening of all the voluntary muscles;

5. by absence of fever, disturbance of the general sensibilities and of the intelligence;

6. to this syndrome are added frequent respiratory and circulatory troubles, which can lead to a more or less rapid death through bulbar paralysis;

7. finally, the characteristic manifestations do not appear earlier than twelve or twenty-four hours after the ingestion of the food and are often preceded by gastro-intestinal troubles that appear gradually and persist for weeks.

The importance of the ocular symptoms is emphasized by Lancaster,[4] who said that "usually the eyes are the first organs to be affected, and in mild cases the paralysis may be limited to the eyes." Dickson[5] stated that a fairly large number of cases are first seen by ophthalmologists and opticians. From the lack of ophthalmologic reports in the literature, one is justified in assuming that among the cases that are seen by ophthalmologists few have been recognized as affected by botulism. Most of the data pertinent to the ocular symptoms have been furnished by others than ophthalmologists.

There has been not a little speculation among writers on this subject as to the manner in which the eyes are affected and also as to the extent of the ocular symptoms. Van Ermengem's tabulation of the ocular lesions is generally accepted, although others have suggested additional symptoms. Ruge[6] reported one case in which he made a diagnosis of papilloretinitis. Uhthoff[7] stated that internal ophthalmoplegia is the most frequent cause of the amblyopia or amaurosis occurring in botulism, but that involvement of the optic nerve may figure in the visual reduction in some cases. He added, however, that there is no positive ophthalmoscopic or anatomic proof of lesions of the optic nerve. Dickson[5] said that there may be initial scintillations and dimness of vision, but changes in the retina are rarely found. De Saint-Martin[8] has reported four cases of involvement of the optic nerve and retina that persisted for months after other symptoms of the intoxication had subsided.

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4. Lancaster, W. B.: Tr. Am. Ophth. Soc. **14**:648, 1916; Ophthalmoscope **14**:588, 1916.

5. Dickson, E. C.: Monograph No. 8, Rockefeller Inst. Med. Res., 1918.

6. Ruge, S.: Klin. Monatsbl. f. Augenh. **40**:408, 1902.

7. Uhthoff, W., in Graefe; Saemisch, and Hess: Handbuch, ed. 2, vol. 11, p. 164.

8. De Saint-Martin, R.: Bull. et mém. Soc. méd. d. hôp. de Paris **44**:52 1920.

Van Ermengem and his associates made the first researches with *Bacillus botulinus* and its toxin. As a result of the histologic studies of Marinesco,[9] they recorded the following:

> In the central nervous system, the lesions in the cerebrum are almost nil. They are absent in the nerve fibers, very pronounced in the cord; less so in the medulla, pons and crura. In the cord and pons they are found almost exclusively in the anterior and posterior cornua.
>
> In the first stage, one finds in the nerve cells only a diminution of chromatophyl elements which begins at the periphery. Later, the Nissl bodies are changed into fine powder-like granules; later still, vacuoles are formed through disintegration of the achromatic substance. These chromatolytic degenerations have been observed in the nucleus of the hypoglossus, nucleus ambiguus, dorsal nucleus of the vagus, in the Purkinje cells of the cerebellum and in the median group of the oculomotorius. Side by side with these regressive lesions of the nerve cells, there are progressive changes in the glia. The glia cells are increased in number in several locations where they have the rôle of neurophages, that is, they remove the diseased elements. Finally, on the part of the capillaries there are always more of less diffuse hemorrhagic foci located interstitially in the gray substance of the posterior cornu, especially the bulbar and oculomotor nuclei.

In essentials, these observations were corroborated by Kempner and Pollack [10] in 1897, by Ossipoff [11] in 1900 and by Römer and Stein [12] in 1904.

In 1914, a human case was reported by Wilbur and Ophüls [13] in which the necropsy showed "no evidence of destruction of the ganglion cells of the various motor nuclei." Their report did not specifically deny the results of the researches of the European physicians, but it assuredly did not give them any support. Two questions have naturally arisen. Does botulism differ in its effects on man and on animals? Is there any other explanation of the symptoms of botulism than lesions in the brain substance?

Wilbur and Ophüls found such marked thrombosis of the cerebral vessels that they considered the vascular changes to be a probable cause of the symptoms. Dickson and Shevky [14] were of opinion that "the lesions are not of central distribution but are peripheral." Edmunds and Keiper [15] concluded that "all essential symptoms of botulism can be explained by a more or less curare-like paralysis of the endings of the motor nerves to the voluntary muscles, including the diaphragm,

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9. Marinesco, G.: Presse méd. **5**:41, 1897.
10. Kempner, W., and Pollack, B.: Deutsche med. Wchnschr. **23**:505, 1897.
11. Ossipoff, V. P.: Ann. de l'Inst. Pasteur **14**:769, 1900.
12. Römer, P., and Stein, L.: Arch. f. Ophth. **58**:291, 1904.
13. Wilbur, R. L., and Ophüls, W.: Botulism, Arch. Int. Med. **14**:589 (Oct.) 1914.
14. Dickson, E. C., and Shevky, R.: J. Exper. Med. **37**:711, 1923.
15. Edmunds, C. W., and Keiper, G. F.: Action of Botulinus Toxin, J. A. M. A. **83**:495 (Dec. 20) 1924.

and by a more or less complete paralysis of the parasympathetic nerve endings." After seeing seven cases of botulism, four of which were fatal, McCaskey [16] observed that "the clinical picture is certainly that of a peripheral lesion."

EXPERIMENTAL STUDIES

The studies that are discussed in this paper were undertaken to determine whether or not lesions are produced in the ocular tissues by the toxin of *Clostridium botulinum*. Other avenues of investigation were opened up as the work progressed until finally it had to be limited to a few definite problems. In the experiments, the material used was as follows: seven dogs, six cats, nine rabbits, three guinea-pigs, five white rats, three cocks and approximately thirty frogs. The dogs, rabbits, guinea-pigs and rats were given subcutaneous injections of botulinus toxin over the abdomen; the cocks, into the breast; in the cats, the injections were made into the anterior chamber and instillations were made into the conjunctivae; the frogs were employed in furnishing nerve-muscle preparations for pharmacologic experiments. Other animals not included in these figures were two rabbits, two cats and one dog which were utilized for the purpose of obtaining nerve-muscle preparations of the extra-ocular muscles and their associated motor nerves. In the homologue of the external rectus muscle of a cat this preparation was obtained once, but it was not well suited to the purpose. The three specific strains of botulinus toxin were employed, namely, types A, B and C.

The experiments were conducted in the department of ophthalmic research and pathology of the University of Colorado School of Medicine and the department of pharmacology of the Creighton Medical College. These experimental studies have been reported in previous communications,[17] but as they represent the first ophthalmic research that has been attempted in botulism, it is hoped that a brief résumé of the work will not be out of place.

In order to subject the animals to the intoxication over a longer period, sublethal doses of the toxin were used and repeated in preference to one large, fatal injection. In order to rule out possible postmortem degeneration, autopsies were performed immediately after death on all animals studied for histologic changes in the eye and brain. In many instances in which death was imminent, the eyes were enucleated under ether. Even small amounts of ether caused death and facilitated the immediate removal of the brain.

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16. McCaskey, G. W.: Am. J. M. Sc. **158**:57, 1919.

17. Swab, C. M.: Tr. Am. Ophth. Soc. **27**:383, 1929; Am. J. Ophth. **12**:949, 1929.

There was no apparent relation between the symptoms of salivation and excessive lacrimation in the dogs, as Edmunds and Keiper had observed in their experiments. Two of the seven dogs, or 28 per cent, had oversecretion of tears, whereas 100 per cent had oversecretion of saliva. When an animal was almost constantly discharging mucus from its nose and saliva from its mouth, it was recorded in the protocols as

Fig. 1.—Perivascular infiltration of the optic nerve; × 90.

having hypersecretion. However, there was present in all of the dogs an associated dysphagia. A loss of the normal winking reflex with deep intoxication and dryness of the eyeballs was noted, as was to be expected. If lacrimatory stimulation preceded the loss of the normal winking reflex, the phenomenon was not observed. In the two cases in which excessive lacrimation occurred, it was a continuous symptom for several hours. There was a dryness of the corneas in all of the dogs,

while in four of the group, or 57 per cent, a dull central opacity of the superficial layer appeared. There was pupillary widening in all cases after the intoxication was pronounced, but reaction to light was present until a short time before death. Finally, there appeared to be a complete paralysis of the sphincter pupillae fibers, as evidenced by failure of response to light.

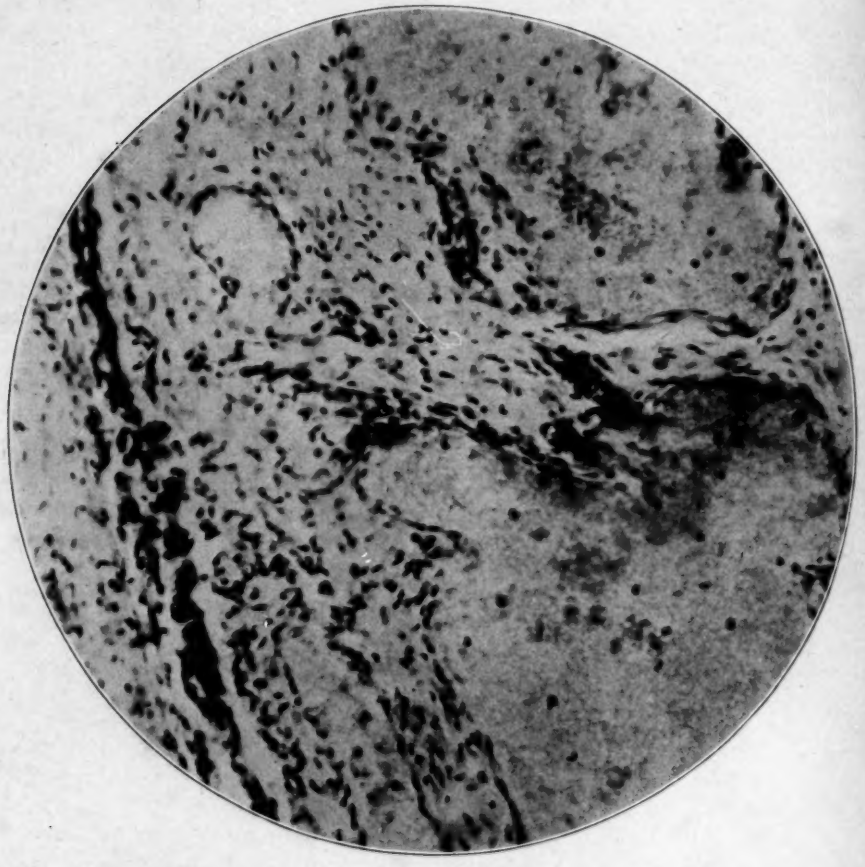

Fig. 2.—Same field of optic nerve as in figure 1; × 200.

Rabbits were found to be more satisfactory than dogs for these detailed studies. They are susceptible to the toxin in smaller amounts, and, being easily and safely handled, are more readily and effectively observed. In none of the rabbits was excessive lacrimation noted. There was no salivation. Dysphagia was present in all instances in advanced stages of the intoxication. This note was entered when mucous râles were heard in the throat of the animal. Dryness of the

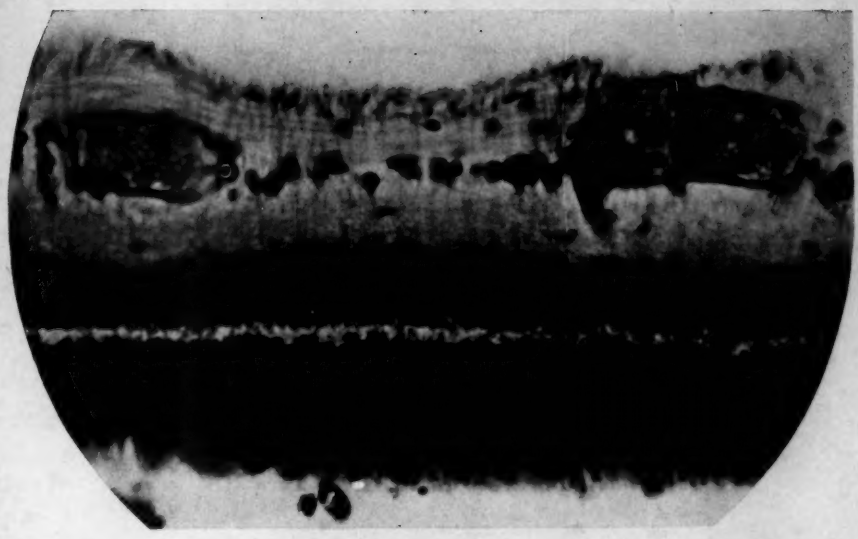

Fig. 3.—Capillary dilatation in the ganglion cell layer of the retina; × 300.

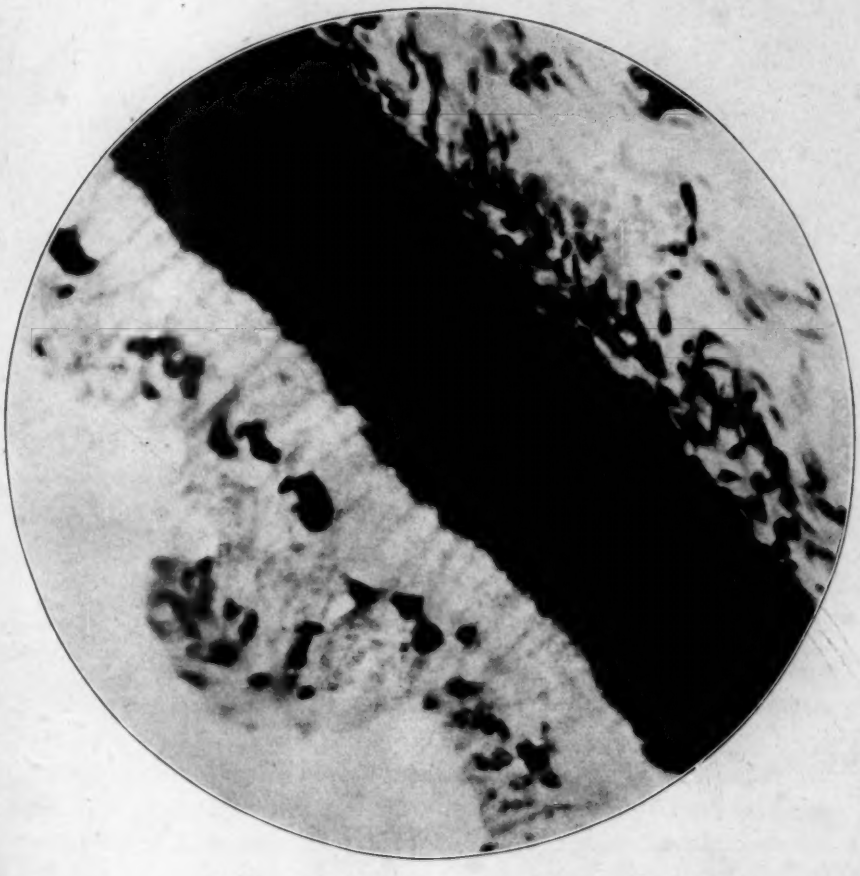

Fig. 4.—Disintegration of the retina; × 400.

corneas was noted in all registered members of the rabbit group except one, which had no eye symptoms, although it lived for six hours after paralysis of the legs and neck had set in. Three of the rabbits were not considered with the group. Two of them had died during the night and were not fit for histologic specimens. The other survived two average lethal doses of the toxin without symptoms and was merely kept for

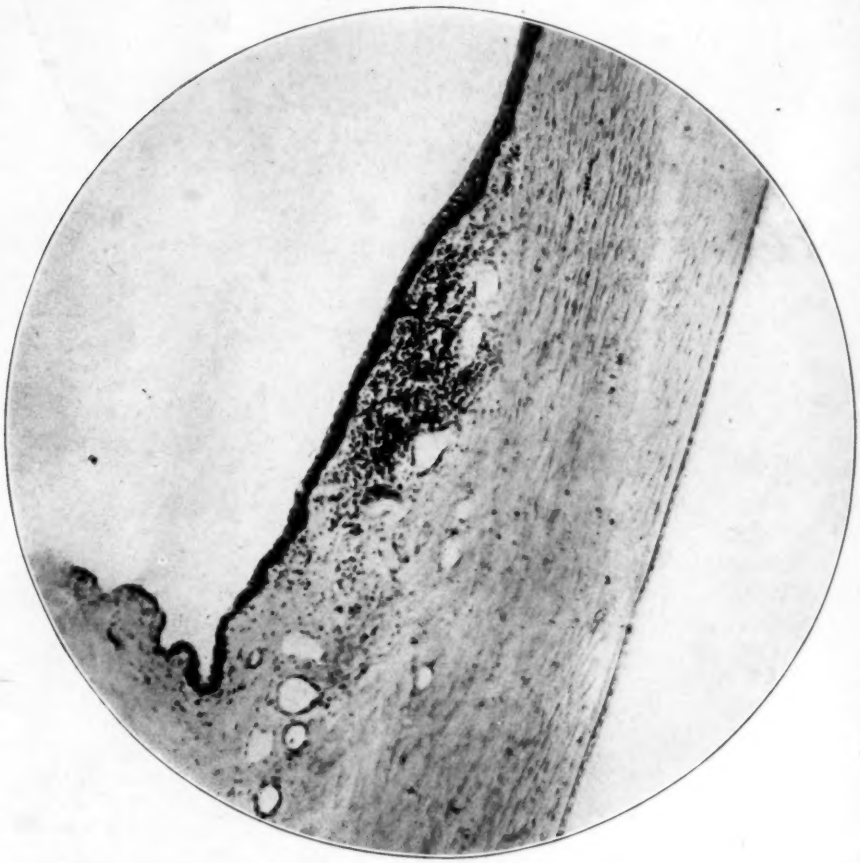

Fig. 5.—Low power, massive restricted perivascular lesion in the corneoscleral junction; × 100.

observation of later symptoms, of which none was noted. Of the six rabbits counted in this group, only one failed to show pupillary widening of at least some notable degree. Chinchilla rabbits of approximately 5 pounds (2.3 Kg.) in weight were used and were checked against normal rabbits of the same age and weight for pupillary measurements. It may be added that the rabbits were all kept in the

same degree of illumination prior to and during the studies. One rabbit, or 16.6 per cent, developed nystagmus and a temporary convergence. Two members of this group had episcleritis at a late stage. One rabbit showed marked sympathetic irritability during the height of the intoxication. This was manifested by a pronounced mydriasis when the animal was agitated. As soon as it became quiet, the pupils con-

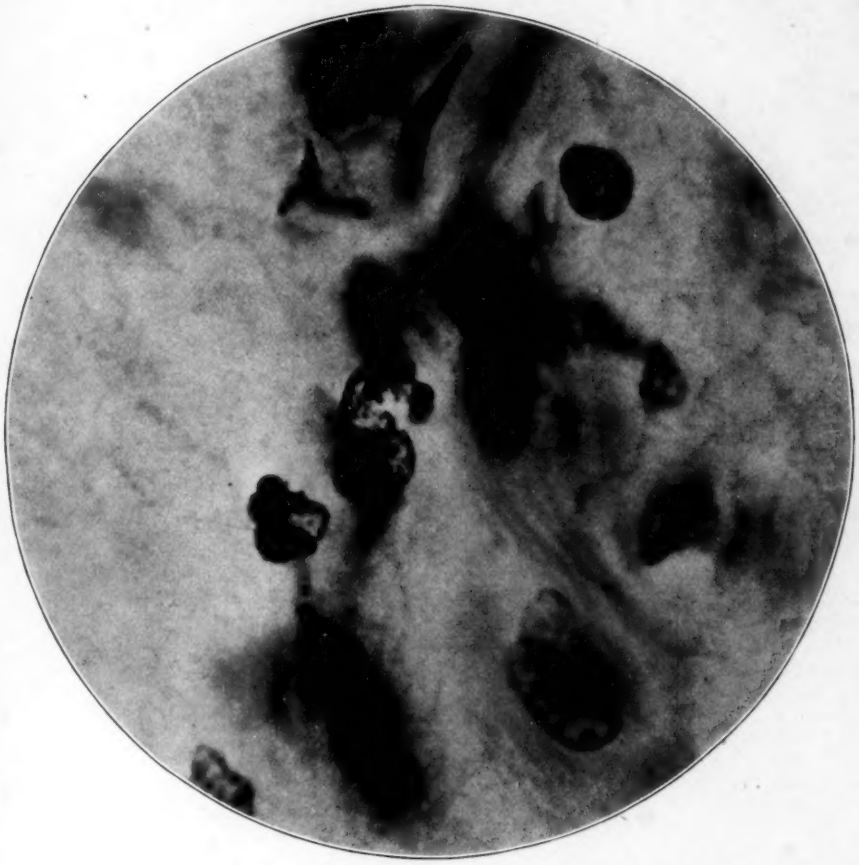

Fig. 6.—Degenerating nerve cells in the optic chiasm; × 1,750.

tracted to their previously normal size. There was no instance in which miosis could not be induced by strong light, although the reflex was not visible as such in some cases.

As the guinea-pigs were very susceptible to the toxin, it was more difficult to regulate their dosage than that for the larger animals. One died during the night and a second died before observations could be made during the period of intoxication. The other member of this

group lived for only twenty-six hours after the injection. Consequently, few notes were made on this group, and only one pig was suitable for autopsy material.

The cocks were given an injection with 0.1 cc. of toxin. Number 1 received type A, number 2 had type B and number 3 received type C. Number 2 showed symptoms of limber neck on the third day. Number

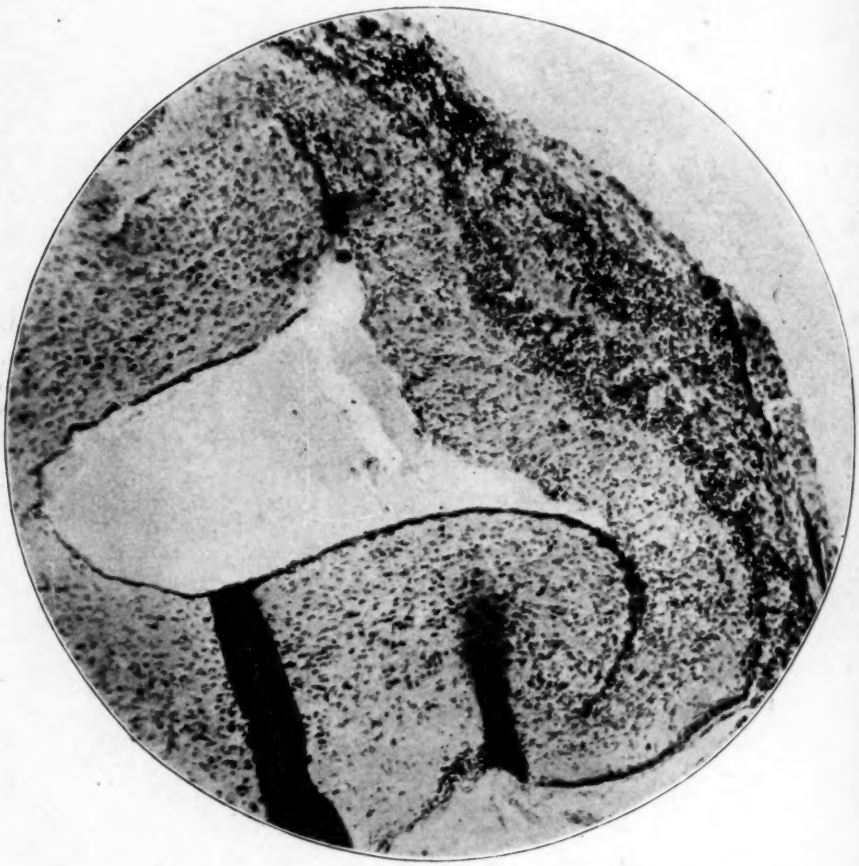

Fig. 7.—Optic chiasm; massive perivascular infiltration; × 95.

1 was symptom-free on the fourth day and was given an additional injection of 0.25 cc. type A. A quiet, droopy condition developed in twenty-four hours, but he recovered without showing any other symptoms. Number 3 received an injection of 0.25 cc. type C on the third day, as it showed no symptoms from the first injection. Two days later mild symptoms of weakness of the wings developed, but there was no paralysis of the neck. As no ocular symptoms had been noted, the experiments

on this group were discontinued, and the cocks recovered. It was concluded that chickens, though known to be susceptible to small quantities of highly potent toxin of *Clostridium botulinum* may show symptoms and yet apparently recover completely.

Two minims (0.12 cc.) of toxin was injected into the anterior chamber of one eye of a cat, the other eye serving as a control study of

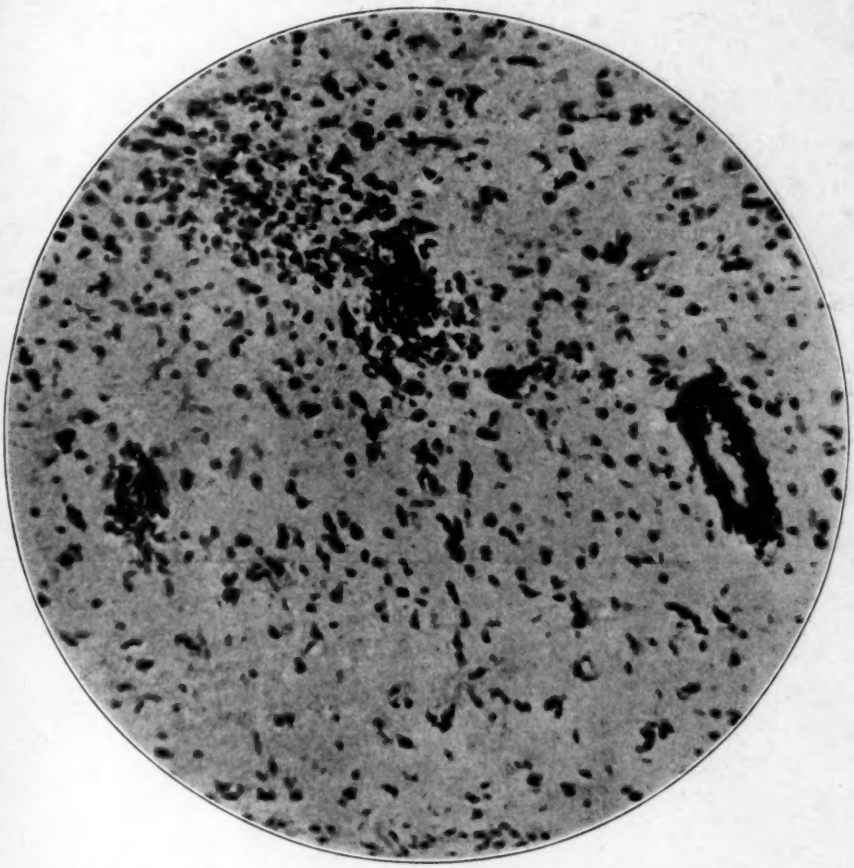

Fig. 8.—Focal infiltration with interspersed migrating lymphoid cells; also perivascular infiltration in the midbrain; × 225.

pupillary effect. This was done with types A, B and C, each in a different cat. There was no apparent result from the toxin, nor was there any effect in the pupil after instilling undiluted toxin into the conjunctival sac.

As the albino rats were too readily susceptible to the toxin, no suitable autopsy material was obtained from this group. All died without affording a chance for study during the period of intoxication.

It has been shown in a previous report [16] that the toxin of *Clostridium botulinum* is a protoplasmic poison to peripheral nerve and striated muscle tissues, being more selective in its effect on the former. It has been suggested that it may be a general protoplasmic poison.

The histologic changes in the nuclei of the third and fourth cranial nerves were: round cell infiltration; lymphoid cells packed into the paren-

Fig. 9.—Perivascular infiltration in the meninges of the midbrain; × 90.

chyma; extravasation of red blood cells; distention of capillaries with erythrocytes; stagnation of blood; migration of lymphoid cells; thickening of capillary endothelium; neuronophagia, chromatolysis, satellitosis, necrobiosis, nuclear displacement, nuclear shrinking, vacuolization, powdery granulation of Nissl bodies and complete disintegration of the ganglion cells; increase of neuroglia. Similar changes were observed in other parts of the midbrain. Besides a diffuse small round cell infiltra-

tion beneath the ependymal lining of the third ventricle, there were diffuse round cell infiltration and massive extravasation of erythrocytes in the meninges. The meningeal vessels were distended with red corpuscles. Thrombosis was not frequent in the midbrain. The changes in the optic nerves were: focal infiltration in the parenchyma, diffuse increase of neuroglia, and round cell infiltration of the pial and arach-

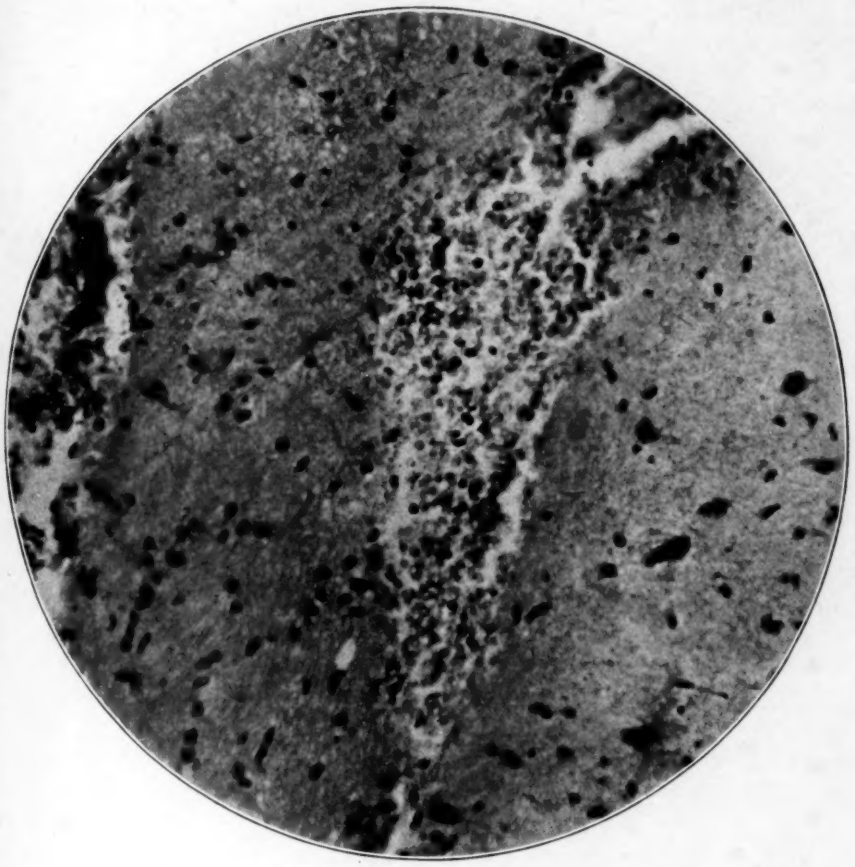

Fig. 10.—Hemorrhagic lesion in the midbrain; × 300.

noidal sheaths. The changes in the optic tracts were: round cell infiltration, extravasation of erythrocytes, emigration of lymphoid cells and stagnation of blood. The chiasmal changes were: maximal infiltration, excessive packing of lymphoid cells in the parenchyma and extensive extravasation of red cells. The retinal changes were: fat formation in the ganglion cell layer; pyknosis, chromatolysis and vacuolization of the ganglion cells; a powder-like reduction of the pigment granules;

engorgement of the vessels with red corpuscles and stagnation of blood. In the choroid there was maximal infiltration involving all layers. There was round cell infiltration of the corneoscleral junction. In the ciliary body there was round cell infiltration together with an increase in the connective tissue element.

The exudative lesions consisted chiefly of lymphocytes and monocytes, some of which had differentiated into polyblasts while others had become transformed into plasma cells. The exudate occurred for the most part about the vessels, but in many instances there was a tendency to migration into the parenchyma. Where maximal infiltration was noted as many as fifteen rows of lymphoid cells were present around the vessel.

Ophthalmologic Review

SOME PRACTICAL POINTS IN TONOMETRY*

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Ophthalmologists are agreed that the outstanding evidence of glaucoma is an increased intra-ocular pressure which can be gaged satisfactorily with the aid of the tonometer. This instrument is especially valuable in the early diagnosis of glaucoma simplex and serves as an accurate guide for medical and surgical treatment. This paper is intended to furnish a brief review of the subject of tonometry in the light of some recent investigations.

The contour and consistency of the eyeball is maintained by the physical state of the eye and the intra-ocular pressure to such a degree that any increase or decrease of the intra-ocular pressure is transmitted to the cornea and other structures. Such a change in tissue tension is detected by indirectly measuring the corneal impressibility.

Corneal impressibility is elicited by placing the instrument accurately on the cornea, where it will exert enough pressure to force its plunger to impress the cornea. In the use of the Schiotz tonometer, the force necessary to impress the cornea is transmitted to a lever the upper end of which points to the dial on the millimeter scale. The degree of the impression is highly magnified on the scale and is estimated mathematically. The scale reading can be interpreted in mercury equivalents by referring to the diagram which accompanies the instrument, the method of transposition being well known. The four empiric curves or graphs on the diagram represent the four weights accompanying the Schiotz tonometer. They are constructed in accordance with average values obtained by simultaneous tonometric and manometric experiments on eyes of dead human beings.

Priestley Smith has said that the tonometer measures the amount of corneal impressibility, and from this one can infer the intra-ocular pressure. While the term tonometer is, therefore, not strictly correct, it is still the best to be had for the scientific and clinical examination of the intra-ocular pressure.

For the determination of absolute intra-ocular pressure, manometric measurements are necessary. Schiotz' method consists in inserting a

* Submitted for publication, Jan. 6, 1930.
* Read at Meeting Section of Ophthalmology, New York Academy of Medicine, Nov. 18, 1929.

fine hollow needle 0.5 mm. in diameter into the anterior chamber. At one time he used a larger bore and inserted it into the vitreous. These changes have necessitated alteration of Schiotz' graphs and mercury equivalents, as they are found to be too low. The needle is connected by rubber tubing to the manometer from which readings are made. Naturally, this method is not applicable to human eyes except when they are useless or require enucleation. As in these cases the internal structure and circulation are markedly affected, the determination cannot be absolute, but relative. Manometric measurements of human eyes are rare. Wahlfors, in 1888, registered the normal pressure at 26 mm. of mercury. Wessely, in 1916, reported two cases of small cell sarcomas; in one, it registered 22.5 mm.; in the other, 18.5 mm. of mercury. Seidel, in 1922, reported 25 mm. of mercury as the normal. In the two former reports, Schiotz' tonometer was used.

In 1905, Schiotz reported the normal intra-ocular pressure as 25 mm. of mercury in eight enucleated eyes. In 1919, Priestley Smith and McLean reported that Schiotz' mercury equivalents were too low. In 1920, Schiotz confirmed Priestley Smith's and McLean's observations, on the basis of the examinations of ten human eyes in situ, and in 1924, he examined thirty human eyes in situ; twenty were from persons dead for from eight to forty-eight hours and ten from one to two hours. In these examinations he again found that the mercury equivalents were too low by 4 mm. In 1926, he published new graphs and the new model.

In a more recent publication, Schiotz stated that the deflection of the pointer does not represent a precise pressure but a pressure range indicated by a maximum and a minimum curve; he accepted the medium one. This, he claimed, is due to a difference in size, thickness and elasticity of the eyeball in different persons. In the majority of cases, however, this difference, if any, is slight and can be considered as negligible for clinical calculations.

Digital palpation, or digital tonometry, although universally practiced, is mainly valuable in cases with definite changes in the intra-ocular pressure or when the instrument is not available. This method is not as frequently practiced as formerly, for it cannot be relied on because of differences in thickness of lids and because tactile sensibility varies in different persons. Absence of curves or graphs recording the course of a case and a possible failure to detect an early rise in pressure are also factors to be reckoned with. For years, ophthalmologists, especially Donders and his pupils, attempted to construct tonometers to replace digital tonometry, but without avail.

In 1874, Hammer, working under Donders, constructed an impression tonometer, which was followed by the introduction of those by Priestley Smith and others. For some years, the study of tonometry

was at a standstill, until Professor Schiotz in 1905 constructed an accurate and reliable instrument based on the principle of corneal impression. This gave an impetus to the study. In 1912, Gradle presented his modification, followed by McLean in 1914. In 1916, Souter presented an instrument based on a spring action. Then came the mercury tonometer in 1921, Bailliart's tonometer in 1923, and several others.

The Schiotz tonometer is now in general use. Its mechanical parts, methods and principles of application are well known. The new model and graphs of 1926 have some definite changes. The new as well as the old instruments have all been made according to Schiotz' original control tonometer. Therefore the deflections of the pointer reading of the new model have remained the same, but their translations into mercury equivalents has been altered to harmonize with the revised charts, for reasons previously stated. A new model is not essential, but one must have a copy of the new chart in order to correct previous records wherever mercury equivalents were employed.

The new model tonometer has the following advantages: it has a double upright rod on each side which assists in balancing the instrument; the cylinder has ball bearings instead of disks; the 5.5 Gm. weight is attached to the rod and the extra weights are placed on top of it, thus avoiding the necessity of screwing the weights on and off and also the dropping of the rod from the sheath.

Schiotz uses a 2 per cent holocaine solution for anesthetizing the the cornea, as it has no effect on the intra-ocular pressure nor does it cause mydriasis. He tested his instrument on the corneal cap accompanying each instrument, which should register at 0. Other points on the scale should be tested, but so far this procedure has not been made feasible.

After the patient is placed in proper position and the external examination has been made, the eyes should be properly fixed. The fixation of the eye is so adjusted as to stabilize its equatorial meridian in a horizontal direction. The tonometer should be held perpendicularly over the center of the cornea without using any pressure on the instrument, and should be held steadily while it is in operation. The pointer oscillates at first and then fixes a reading on the millimeter scale. The greater the pressure, the less the excursion; the less the pressure, the greater the excursion. If the intra-ocular pressure is normal, the use of the 5.5 Gm. weight will give a pointer deflection on the scale between 3 and 6 mm. If the reading is less than 1 mm., the next higher weight is used, namely, 7.5, 10 and 15 Gm. weights, until a reading of 2 mm. on the scale at one end or 6 mm. (highest) at the other end is reached. Experience has shown lower or higher readings to be unnecessary. Soft eyes give unsatisfactory results.

The normal limits of the pointer deflection lie between 3 and 6 mm. on the scale when the 5.5 Gm. weight is used. This reading translated into mercury equivalents gives an average intra-ocular pressure, according to the calculation, of 29 mm. of mercury, which should be referable to a minimum reading of 26 mm. of mercury or a maximum reading of 33 mm., demonstrating that the pointer deflection on the scale does not represent a precise pressure but a pressure range that is greater as the heavier weights are used. Priestley Smith and Schiotz stated that absolute mercury equivalents from the scale reading cannot be made until after numerous simultaneous tonometric and manometric measurements on living eyes are possible. They suggested that all tonometric measurements be recorded in the form of a fraction—the numerator representing the weight used, the denominator, the number of millimeter deflection on the scale.

The readings on the scale of the new Schiotz tonometer between 3 and 3.5 mm. (5.5 Gm. weight) require observation of the patient at various intervals; a reading between 2.5 and 3 mm. arouses suspicion, and a reading of less than 2.5 denotes pathologic conditions. The use of the higher weights gives comparative results.

These readings require accurate judgment, since it is difficult at times to note at which reading on the scale the pointer remains stationary. This is due to the vibration of the pointer caused by air currents or unavoidable pulsations from other sources. A variation of 1 mm. on the scale makes a difference of 5 mm. in the mercury equivalent reading. Therefore the scale reading in the form of a fraction, as suggested, is preferred by some ophthalmologists.

Professor Schiotz' X tonometer is similar to the 1926 model, except that the bottom of the plunger is now convex and usually no weights need to be inserted. Only one weight, 2 Gm., is added in case the tension is high. The normal readings, without weights, lie between 9 and 14 mm. When the 2 Gm. weight is used, the most reliable results lie between 4 and 16 mm. For translation into mercury equivalents, only two graphs appear on the chart accompanying this instrument. I have had no experience with this model.

Some ophthalmologists make three tests and accept the average reading on the scale. Too many applications or too heavy weights on the rod applied for any length of time, especially in elderly persons, should be avoided, as such a procedure is apt to cause corneal defects. According to some investigators, the use of the heavier weights is apt to cause an increase in the ocular drainage, but as yet such interpretations have not been satisfactorily proved.

If one allows the tonometer to remain quietly on the cornea for several seconds, pulsations of the lever ranging from 0.5 to 1 mm. are

sometimes observed. Bailliart, in 1919, made use of this phenomenon in the registering of the diastolic pressure in the intra-ocular arteries.

Systematic tonometric measurements have shown that there are daily fluctuations in the reading; it is slightly higher in the morning than in the late afternoon. This is explained as being due to a temporary hyperemia caused by the position of the head during the night, which indirectly increases the intra-ocular pressure. This normal fluctuation has suggested the advisability of having record charts after the manner of temperature charts, in order to indicate fluctuations at different times of the day over extended periods. Such records would at a glance give an idea as to the intra-ocular pressure in respect to the course of the disease and the tonometric effect of the use of various drugs and of surgical procedures. Fluctuations should also be recorded for future inspection in cases in which one ophthalmologist makes a morning and another an afternoon reading.

The age of patients shows no variation in the corneal tonometric reading; this applies also to sex. Scleral tonometry, performed with a special foot-plate, has shown a lower reading in the young patients on account of the sclera being more elastic. Changes in altitude produce no alterations in the tonometric readings. Marked refractive errors in myopia, hyperopia, astigmatism or disturbances of accommodation or convergence do not influence the intra-ocular pressure.

Some ophthalmologists advise their patients with glaucoma with normally reacting irides to read at close range for long periods at a time, claiming that the contracted pupil reduces the intra-ocular pressure. Recent investigations have demonstrated that there is no tonometric reduction under these conditions; also, that in dark adaptation, the intra-ocular pressure is increased.

According to recent studies, the question of a direct parallelism between increased intra-ocular pressure and dilatation of the pupil and decrease of pressure with contracted pupil has not been established. In cases of partial aniridia with increased pressure, the latter was reduced with miotics without obviously affecting the size of the pupil. In addition, cases of glaucoma with persistent mydriasis have been observed in which miotics caused a reduction of pressure without influencing the width of the pupil. In cases of untreated glaucoma, physostigmine (eserine) has been known, though rarely, to increase the intra-ocular pressure and to contract the pupil markedly. These facts would indicate that pathologic changes in the intra-ocular pressure do not depend entirely on the diameter of the pupil, and that some other, at present unknown, factor might be responsible for the tonometric variations in pressure. The probable secondary action of drugs which reduce tension is to increase the diffusibility of the aqueous, thereby permitting

better drainage. However, the usual observation is that in glaucoma there is a drop in the tonometric reading coincident with the contraction of the pupil.

In cases of keratoconus, some investigators report an increase of pressure, while the majority of the records indicate that there is no change. This is contrary to what one would expect. It is probable that the weight of the instrument with its corneal foot-plate does not adjust itself to the corneal curvature.

Whether or not increase of blood pressure affects the intra-ocular tension is still a doubtful question. It would naturally be expected that such is the case, but many nephritic persons with persistently increased blood pressure, hypertrophied hearts and chemical changes in the blood do not show any increase in the tonometric reading. On the other hand, some patients with acute and simple glaucoma who have an increased intra-ocular pressure never show any evidence of increased blood pressure. It is a fact, however, that persons with high blood pressure and physically below par who are engaged in hard work are susceptible to glaucoma; the reason advanced for this susceptibility is that it is not alone the increased blood pressure that is responsible, but some change in the chemical composition of the blood which produces an altered condition of the intra-ocular fluid.

According to Hertel, the tonometric reading has been shown to be decreased temporarily in cases of acute glaucoma by the administration of salt solution intravenously or by mouth. The same reduction in pressure in the same condition has been known to occur after venesection or leeching.

Tonometric measurements are taken in other eye conditions as well as in glaucoma, but as these diseases give varied results, owing to their pathology, only those which have a more definite pathology will be considered.

Tonometric observations of intra-ocular tumor and serous detachment of the retina in the early stages have shown that many cases of intra-ocular tumor show no increase in pressure, but sometimes a normal or lowered pressure, while serous detachment shows no lowering of pressure, but frequently a normal pressure. In diabetic cases, a marked lowering in pressure, or hypotony, sometimes occurs, which may rise with injections of insulin. Increase of pressure in the cerebrospinal fluid does not indicate any increase in the intra-ocular pressure. I have at present under observation a case of bilateral simple glaucoma in exophthalmic goiter.

Tonometric measurements are helpful at times in the differential diagnosis of simple glaucoma with excavation and primary optic atrophy with excavation. Numerous investigators assume that glaucomatous

optic atrophy does not originate without an increase in the intra-ocular pressure. Occasionally, however, patients with glaucoma simplex show no increase in the intra-ocular pressure. Various explanations have been advanced for this condition, one being that the existing pressure is high for that person, especially if the noninvolved eye has the same pressure. Another fact to be considered is that the patients have had previous attacks of increased pressure which have subsided at the time of examination. Accurate previous tonometric records in these cases would be of great value. In other cases, if the nondiseased eye shows a lower reading than the diseased eye, this fact should create suspicion of a comparative increase of pressure in the affected eye. It is also of practical importance in glaucoma to make periodic tonometric measurements in the nondiseased eye for evidence of an early rise in pressure.

Judging from the facts here presented, it becomes evident that tonometric measurements may not be of any service in the diagnosis of glaucoma unless previous tonometric readings in conjunction with the visual acuity, visual field tests and an examination of the anterior chamber and optic disk have been made.

The lowering of the increased intra-ocular pressure does not depend solely on its degree, but also on the condition of the iris and of the peripheral angle of the anterior chamber, circulatory disturbances, the duration of the disease and the accustoming of the patient to the drug.

In reporting tonometric readings, it is customary to state the instrument employed, since the readings vary at times with different tonometers. Professor Schiotz advised that all tonometers should be standardized, that is, adjusted according to a control instrument at some center. This could be accomplished by the cooperation of ophthalmologists and the manufacturers of tonometers, and would result in more accurate and reliable instruments and uniformity in reports and records. With this in view, a committee was appointed by the last International Congress to report on the standardization of tonometers at its next meeting.

News and Notes

EDITED BY DR. JOHN HERBERT WAITE

GENERAL

Oxford Ophthalmological Congress.—The Oxford Ophthalmological Congress will assemble at Keble College, Oxford, on the evening of Wednesday, July 9, 1930, and the meetings will be held on the following Thursday, Friday and Saturday, July 10, 11 and 12.

On the morning of Thursday, July 10, there will be a symposium on "Toxic Amblyopia," to be introduced from the ophthalmologic standpoint by Dr. H. M. Traquair, of Edinburgh; from the point of view of the physician by Sir Farquhar Buzzard, Bt. K.C.V.O., Regius professor of physics at the University of Oxford, and from the pharmacologic aspect by Dr. J. A. Gunn, professor of pharmacology at the University of Oxford.

On Thursday afternoon, July 10, an address will be given by Sir Oliver Lodge, F.R.S., entitled "Modern Theories on the Nature of Light."

The Doyne Memorial Lecture will be delivered on the morning of Friday, July 11, by Dr. Harry Friedenwald of Baltimore, the subject being "Pathological Changes in the Retinal Blood Vessels and Their Significance."

An address will be given by Prof. Dr. Artur Schüller, of Vienna, on "Recent Developments in Radiology Associated with Ophthalmology."

An address will be given by Prof. Dr. Jules Gonin, of Lausanne, on "Detachment of the Retina and Its Treatment."

Trachoma Among the Indians.—A recent report to the United States Public Health Service shows a reduction in the incidence of trachoma among the Indians of Arizona and New Mexico. Twenty-four per cent of 4,700 Indians examined in 1912, and only 9 per cent of 6,700 examined in 1928 were found to be affected.

International League for Campaign Against Trachoma.—At the Thirteenth International Ophthalmological Congress there was founded an International League for Campaign Against Trachoma, with Dr. Emile de Grosz as president, and Dr. F. Wibaut, secretary. The various ophthalmologic societies represented have nominated forty-nine delegates for the meeting which will be held July 26, at Geneva.

UNIVERSITY NEWS

On March 11 and 13, Selig Hecht, professor of bio-physics at Columbia University, gave the Howe Lectures at Harvard Medical School. He discussed "The Nature of the Visual Process." The first lecture dealt with the quantitative perception of light, in terms of visual acuity. As visual acuity increases along a logarithmic curve with increasing illumination, Hecht believes that visual acuity is best explained by likening the retinal rods and cones to a population, the individual elements of which have various sensitivities. Thus, as illumination increases, at critical intervals groups of rods and cones are brought into play; 472 such intervals have been observed, thirty with rods and 442 with cones. The second lecture dealt with the qualitative perception

of light, in terms of color vision, with its three variables—hue, brightness and saturation. It is possible to obtain any of the 180 perceptible hues in the visible spectrum by the proper admixture of the three primary colors—blue, green and red. Attention was called to the hypothesis of Thomas Young that the human retina contains three kinds of cones; namely, those attuned to blue, to green and to red. Probably these three types of cones exist in the relation of 1:1:1, rather than in the relation of 1:75:100 necessary for the attainment of white through the mixing of blue, green and red.

Dr. James N. Greear, Jr., has been appointed professor of ophthalmology at Georgetown University School of Medicine, succeeding Dr. John W. Burke, who has resigned.

Prof. L. Koeppe has taken up his duties as a permanent member of the Research Staff of the Department of Ophthalmology, University of Iowa. Information concerning instruction in slit-lamp microscopy under Professor Koeppe may be obtained by addressing the Department of Ophthalmology.

Peter Salit, who has been doing research work on the lens and aqueous and vitreous humors, is now associated with Mr. Duke-Elder in London. At the expiration of his leave of absence, Mr. Salit will resume his work at the University of Iowa.

PERSONAL NEWS

Dr. J. Frank Crouch, emeritus professor of ophthalmology at the University of Maryland, has retired from active practice. His office is being continued by Dr. C. C. Clapp, his associate for many years.

Dr. Samuel Theobald, clinical professor emeritus of ophthalmology, Johns Hopkins University, was honored by the ophthalmologic section of the Baltimore City Medical Society on January 23, the fiftieth anniversary of his use of boric acid in treatment of conditions of the eye. Prior to this time, boric acid was used elsewhere than directly in the eye.

SOCIETY NEWS

French Society of Ophthalmology.—The French Society of Ophthalmology will hold its forty-third congress at the Faculty of Medicine of Paris, beginning Monday, May 12. The paper will be presented by Drs. Duverger and Velter: "Biomicroscopy of Crystalline Lens in Normal and Pathological States." During the period of the congress visits will be made to hospitals and laboratories, and there will be an exposition of optical instruments, of ocular surgery and of therapeutic products at the Faculty of Medicine. For all information address the Secretary General, Dr. René Onfray, 6 Avenue de la Motte Picquet, Paris VII.

Cleveland Ophthalmological Club.—At the January meeting, Dr. Edward B. Heckel, of Pittsburg, gave an address illustrated with lantern slides on "Some Personal Observations on Restoration of the Eyelids, and Surgery of the Lids."

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Anatomy and Embryology

THE DEVELOPMENT OF THE LACRIMAL PASSAGES IN MAN. F. SPECIALE-CIRINCIONE, Ann. di ottal. e clin. ocul. **57:** 435 (June-July) 1929.

This is a part of the late Speciale-Cirincione's studies on the development of the eye, published posthumously by the *Annali*. The author made use of the elder Cirincione's collection of human embryos, including six of from 13 to 20 mm., a period which had not been covered by previous observers. He describes altogether eighteen embryos from 4.5 to 130 mm. (at the end of the fourth month). Early in the second month of fetal life a prominence develops just nasal to the eye, and separated from the maxillary and lateral nasal processes by two sulci. This is the origin of the lacrimal caruncle. The author calls the two sulci the superior and inferior lacrimal sulci. As the maxillary and lateral processes develop, the walls of these sulci come in contact, leaving a cord of epithelium, the lamina lacrimale. Part of this persists and gives rise to the lacrimal canals. The inferior part of this cord develops first, reaching the wall of the nasal cavity; the upper one forms more slowly and reaches only to the contiguous part of the inferior cord. During the second month, the upper ends of these cords develop into the lacrimal puncta, which open on the inner side of the lids, the lower one being farther from the inner canthus, as in adult life. The canaliculi are formed from these two cords; the sac developing where they come together, and the deeper end of the inferior cord becoming the nasolacrimal duct. Owing to the development of the nose, this duct, which is at first almost horizontal, becomes almost vertical. The canalization of the lacrimal cord begins in its middle portion, extending to the puncta about the end of the fourth month. The two upper cords may remain independent, forming a double lacrimal sac. The opening of the duct into the nasal cavity does not occur until the latter part of fetal life. (Bibliography.)

S. R. GIFFORD.

ON THE RELATION IN SIZE BETWEEN THE CILIARY MUSCLE AND THE SPHINCTER IRIDIS IN THE NORMAL AND THE AMETROPIC EYE. G. SANNA, Ann. di ottal. e clin. ocul. **57:** 550 (June-July) 1929.

The author examined sections of three eyes with high myopia and seven normal eyes, measuring the relative thickness of the two muscles in sagittal section. He found great variation in the size of the ciliary muscle, which was, as would be expected, much smaller in myopic eyes. The sphincter, on the other hand, was remarkably constant in size. Evidently the sphincter is subject to such constant use by the con-

traction of the pupil to light and convergence that the additional work of contraction to accommodation plays no appreciable part in its development.

S. R. GIFFORD.

ANATOMY OF THE OPTIC CANAL. M. DEL DUCA, Riv. oto-neuro-oft. 6: 215 (May-June) 1929.

Del Duca, in order to clear up contradictory opinions about the pathologic conditions of the optic canal, has made a restudy of its bony structure in ninety skulls chosen from the magnificent collection found in the Institute of Legal Medicine in Rome.

He draws the following conclusions: The optic foramen acquires its canalicular form in the first years of life, and reaches its final and average length between the ages of 10 and 11 years; its shortest or inferior wall is, then, 7.2 mm. long. Some authors (Goalwin) have maintained that the lateral wall is shortest. Any forward displacement of the carotid groove of the sphenoid affects the length of this inferior wall.

Where the medial wall is dehiscent or perforated, a direct communication exists between the canal and the adjoining sphenoid sinus.

The internal orifice of the canal is elliptical and its major axis is almost horizontal. The external orifice is ovoid and its major axis is vertical. Respective malformations of a triangular or biscuit shape are determined by variations in the passage of the ophthalmic artery. The size of the orifices, measured by their principal axes, is given in an extensive table with maximal and minimal averages.

The distance between the two internal orifices is in direct relation to the width of the sphenoid body, according to the types of brachycephaly and dolichocephaly.

Asymmetry of the extremities of the sphenoid disturbs the relation of one internal orifice to the other; when one is on a different level, the orifice is displaced forward, or presents variations of inclination downward, forward or laterally.

A high, thickened, quadrilateral lamina, with or without hyperostoses, and clinocarotid or clinoclinoidal canals, whether unilateral or bilateral, complete or incomplete, as well as malformations of the orifices determined by the passage of the ophthalmic artery, are not uncommon and must be remembered.

In the few cases of macrocephaly and microcephaly, acrocephaly and scaphocephaly reported, measurements did not differ from the average. Except between the ages of 5 and 11, age does not cause any variation. The author has had no access to the skulls of infants.

In the researches of Goalwin, it was found that the angle formed by the plane of the optic canals with the horizontal plane of the Germans has a value of 37.9 degrees, and that the angle made by the axes of the canals with the median plane is 38.3 degrees. Del Duca insists that these angles are susceptible of great variations, individually and collectively. The slightest torsion of the sphenoid, or a more or less marked development of one half of it, to mention only one of the varia-

tions in the direction of the canal, is sufficient to determine conditions the summation of which contributes to giving ever varying values to the angles found by Goalwin.

V. R. SYRACUSE.

RADIOGRAPHIC AND CLINICAL CONSIDERATIONS OF THE OPTIC CANAL. M. DEL DUCA, Riv. oto-neuro-oft. **6:** 307 (July-Aug.) 1929.

Roentgen study of the optic canal presupposes an exact knowledge of the anatomy of that region and of all its malformations and anomalies.

Among the various positions described as modifications of the original methods of Rhese, the methods of Balli and of MacMilliams, respectively, are those that give better results. These methods can be improved by appropriate and slight modifications in the position of the head. The central ray must pass through a point situated from 7.5 to 8 cm. above the apex of the mastoid of the other side, and from 3.5 to 4 cm. behind its anterior margin.

For the sake of orientation, a lateral view of the head should be taken before a view of the optic canal proper.

In the oblique projection of the head the image of the optic canal falls from 2 to 3 mm. from the external wall of the orbit, beneath a horizontal line made by the projection of the spheno-ethmoidal plane.

The roentgenographic image of the optic canal is the resultant of the two superimposed images of its internal and external orifices; its diameters correspond to the smallest diameters of the respective orifices. Its ovoid form with a horizontal or vertical major axis, or its circular form, depends on the relation of the sum of the vertical and horizontal axes of the two internal and external orifices.

A false position of the head, inclination of the central ray and variations in the distance between tube and head and between head and film have an influence on the form and size of the image of the canal.

The passage of the ophthalmic artery and the presence of a clinocarotid canal or of a thickened and high quadrilateral lamina alter the form and the clearness of this image.

Traumatic lesions and tumors of the walls of the canal are shown roentgenographically by an absence of particular walls.

Various clinical cases are related to prove the truth of these assertions; among them are cases wherein a study of the optic canals is of the greatest help in arriving at a diagnosis or, at least, in making a roentgenographic study of other positions more complete.

V. R. SYRACUSE.

Physiology

RELATION BETWEEN INTRA-OCULAR PRESSURE AND GENERAL BLOOD PRESSURE. H. KAHLER and L. SALLMANN, Arch. f. Ophth. **122:** 634 (Aug.) 1929.

It is well known that there is no relation between the absolute figures for the intra-ocular tension and the general blood pressure. The authors studied the influence of brief variations of the blood pressure.

which were experimentally produced, on the intra-ocular tension. They put their patients in a partial or complete hot or cold bath and watched blood and intra-ocular pressure. If only the arms or the legs were put in cold water, the blood pressure increased from 7 to 25 mm. while the intra-ocular pressure dropped 2 mm. or more. A hot bath usually had the opposite effect. The blood pressure dropped and the tension of the eyes increased. In all these experiments a certain amount of massage of the eye caused by the frequent tonometries was taken into consideration. The changes of the intra-ocular pressure in these experiments were explained by variations of the caliber of the intra-ocular vessels which go parallel to the changes of the vessels in the skin. Some experiments were carried out with amyl nitrite and with caffeine. The results confirmed the former experiments in which the vessels of the skin reacted to low or high temperatures. It can be concluded that the intra-ocular vessels participate in the vasomotor reactions of the skin to a considerable extent.

P. KRONFELD.

Congenital Anomalies

CONGENITAL IRIS ANOMALIES: APLASIA SEMICIRCULAR IRIDIS CIRCUMPUPILLARIS. HANS LIEBITZKY, Arch. f. Augenh. **100-101:** 771, 1929.

Two cases are described which show a congenital bilateral crescent-shaped aplasia of the sphincter muscle of the iris. This was associated with a pear-shaped pupil, a lack of development of the pupillary margin and anomalies of the anterior layers of the iris. This forms a typical symptom-complex which seems to be exceptionally rare. The cases that have been reported in the literature are reviewed.

Liebitzky points out that this anomaly is seen almost exclusively in light grayish-blue irides. The lack of development of the pupillary margin can be looked on as an anomalous development of the ectoderm which may progress to an absence of the dilator muscle and an aplasia of the sphincter. With this one sees changes in the mesodermal layers of the iris of varying degree so that the author is inclined to regard the primary cause as a failure of development of the pupillary portion of the pars iridica retinae, secondarily associated with varying degrees of anomalous formation of the anterior mesodermal layers. A third case is reported which showed an anomalous formation of the mesodermal layers with no malformation of the ectodermal derivatives.

F. H. ADLER.

Vision

RUBESCENT VISION AS EARLY SYMPTOM IN UREMIC DISEASES. E. VINAZZER, Med. Klin. **25:**1395 (Sept.) 1929.

Vinazzer reports three cases with disturbance of the urinary passages. The patients complained that at times everything became red before their eyes. All three developed uremia. The author concludes that rubescent vision is an early symptom of uremia. He thinks that

the condition is due to changes in the fundus oculi. Whenever the differential diagnosis is difficult, this symptom may be considered as pathognomonic of uremia.

W. ZENTMAYER.

Refraction and Accommodation

PREMATURE PRESBYOPIA IN GLASSBLOWERS AND OTHER BLAZE-WORKERS. R. LEDERER, Klin. Monatsbl. f. Augenh. **82**: 656 (May 17) 1929.

With the aid of several tables, the author presents the damages done to the accommodation among glassworkers. He found that both eyes are affected unequally in many workers. All but one of thirty-three men occupied at flames were prematurely presbyopic; three of these were blacksmiths and thirty were glassblowers. Nine were prematurely presbyopic on one eye, nine to a higher degree on one eye and fourteen on both eyes. The eighteen men of the first group stated, with two exceptions, that one eye was more exposed to the fire than the other. On the results of these examinations the author bases the opinion that the premature aging of these industrial workers cannot cause the early appearance of presbyopia. This opinion is supported by another series of 205 persons occupied at fires, sixty-three of whom (forty-three women and twenty men) showed premature presbyopia. Any error due to latent hyperopia could be excluded; menopause and other physical conditions were also given due consideration. The so-called glassblowers' cataract was ruled out for these examinations; detachment of the capsular lamella and beginning cloudiness of the pole of the lens were noticed only in one case each.

In agreement with Elschnig and the Glass-Workers' Committee, the author places the evil reaction of the glaring heat on the iris and ciliary body, but not on the lens itself. Meesmann arrived at the same conclusions with reference to the roentgen cataract.

K. L. STOLL.

Physiologic Optics

THE BEHAVIOR OF THE COLOR SENSE IN AMETROPIA. G. LODDONI, Ann. di ottal. e clin. ocul. **57**: 539 (June-July) 1929.

The author describes the chromatic aberration of the eye, by which red rays are refracted less than blue rays and hence focus behind the retina when blue rays are focused on the retina. This produces red diffusion circles when blue rays are in focus and vice versa. Sixty-four cases of anisometropia were studied with Nagel's anomaloscope to ascertain what effect, if any, their refractive error would exert on the mixture of red and green required to match yellow. It might be expected that the myopic eye, being more nearly in focus for the red rays, would be more affected by the blue diffusion circles and hence would require more red to give an equation, while the hypermetropic eye would require more red. While the results varied somewhat, observations with the anomaloscope tended to bear out this theory. (Bibliography.)

S. R. GIFFORD.

Experimental Pathology

EXPERIMENTAL STUDIES OF THE CHANGES IN NORMAL EYES AFTER EXPOSURE TO X-RAYS. PART FOUR: THE SENSITIVENESS OF SINGLE PARTS OF THE RABBIT EYE TO ONE EXPOSURE. W. ROHRSCHNEIDER, Arch. f. Ophth. **122:** 383 (July) 1929.

This paper deals with the question of which quality of the x-rays does the least amount of damage to the eye. The author differentiates the "effect" of x-rays and the "damage" done by x-rays. By "effect," he means changes which occur on groups of cells which can be repaired by regeneration. By "damage," he means changes which are not reversible. Among the tissues of the eye the lens is the most sensitive. "Damage" of the lens is caused by one shot of the epilation dose. As long as only reversible changes of the tissues are concerned no difference was found between the action of soft and of hard rays. If one deals with quantities which are likely to cause damage, soft rays seem more dangerous than hard rays.

P. KRONFELD.

Bacteriology

THE ACTION OF ANILINE DYES ON GERMS. H. STÜDEMANN, Arch. f. Ophth. **122:** 572 (Aug.) 1929.

The author made very extensive studies of the influence of the common aniline dyes on the growth of bacteria. The germs studied were: anthrax, coli, Koch-Weeks, diphtheria, pyocyaneus and typhus. For each type of germs, the minimum killing dose of the single dye and of certain combinations was determined. For cases of anthrax of the lids "brilliant green" should be tried first.

P. KRONFELD.

THE GERMS FOUND ON THE SURFACE OF THE NORMAL CORNEA. A. BLANK, Arch. f. Ophth. **122:** 661 (Aug.) 1929.

The author took smears from the surface of the cornea of patients with normal anterior segment. He used cotton applicators which he put in serum bouillon. In 102 of 194 eyes he found the same germs in the smears from the cornea and the conjunctiva. The results were: Pneumococci were cultivated in 52 per cent, staphylococci in 78 per cent, xerosis in 66.5 per cent, diplobacilli in 4 per cent and *Bacillus subtilis* in 2.5 per cent. In older persons, pneumococci are found more frequently than in normal eyes of younger persons.

P. KRONFELD.

Serology

THE OPHTHALMO REACTION IN CONJUNCTIVAL DISEASES, ESPECIALLY TRACHOMA. A. MARINOSCI, Ann. di ottal. e clin. ocul. **57:** 524 (June-July) 1929.

The ophthalmo reaction with tuberculin, checked by the Pirquet and Mantoux tests, was performed on healthy persons, tuberculous patients with normal eyes, tuberculous patients with ocular inflammations and patients with trachoma. While it was negative in non-

tuberculous persons, it was positive in only half of the tuberculous patients with normal eyes. In tuberculous patients with external ocular diseases (blepharitis, conjunctivitis, etc.), the test was always positive, while of sixty-nine tuberculous patients with trachoma, only nine gave a positive test. These were all early cases, and the conclusion is drawn that the changes of chronic trachoma interfere in some way with the reaction. No serious lesions were produced by any of the positive reactions, but the author believes that the reaction is not constant enough to constitute the diagnostic method of choice in tuberculosis.

S. R. GIFFORD.

CONDITIONS IMPORTANT IN LOCAL IMMUNIZATION AND IMMUNOTHERAPY OF INFECTIONS OF THE EYE. L. I. POLEFF, Arch. oft. **6:** 166 (Oct.) 1929.

The author believes that tissues of the eye produce antibodies only in infections caused by "ophthalmotropic" bacteria, such as trachoma virus, Morax-Axenfeld diplobacillus, etc.

He gives a summary of the recent clinical and experimental data on local immunization by the Besredka antivirus or bouillon filtrate method which shows that local immunity of the eye is possible, especially in the lid, conjunctiva and cornea. The immunity is neither absolute nor permanent, because the technic requires further perfection and adjustment to the histopathologic peculiarities of the eye.

He suggests the following: 1. To observe the correlation between the virus and antivirus, i. e., the use of filtrates prepared from virulent cultures isolated from the affected eye (autogenous antivirus). 2. Preparation of the antivirus against the main inciting micro-organism, other conditions being considered simultaneously, such as mixed infection, anomalies of refraction, general consitution of the patient, etc. 3. The proper use of the filtrate, i. e., the removal of conditions interfering with its action. 4. Combination of local immunotherapy with the usual surgical and medical treatment which may become more effective after the local immunity has increased.

It is advisable to select a virulent strain for the preparation of the bouillon filtrate and to have the filtrate act on the tissues of the eye superficially, but for a prolonged time.

O. SITCHEVSKA.

Conjunctiva

MELANOSIS CONJUNCTIVAE. M. ZEIDLER, Arch. f. Ophth. **122:** 628 (Aug.) 1929.

A man, aged 70, developed a small brownish spot in the conjunctiva of the left eye. Ten years later, the brown tissue was easily and radically removed and showed spindle-shaped pigmented cells. One year later, the patient returned to the clinic with a dark tumor in front of the left ear. The tumor was excised and found to be a melanotic sarcoma. Two years later, the conjunctiva of the left eye at the lower limbus showed a few brownish spots which increased in size and finally led to a diffuse brownish thickening of the conjunctiva all around the limbus. A biopsy was done, but no definite histologic diagnosis could

be made. The tissue looked like a nevus, but certain parts suggested the possibility of beginning sarcoma. The diseased conjunctiva was removed in several steps, but one year later the pigmentation had recurred. The author did an exenteration of the orbit which unexpectedly revealed not the slightest sign of malignancy. Therefore, a diagnosis of melanosis was made. The pigment in this case was formed exclusively by the epithelium.

P. KRONFELD.

Cornea and Sclera

DENDRITIC KERATITIS. M. H. POST, Am. J. Ophth. **12:** 884 (Nov.) 1929.

The literature is reviewed, and the influence of malaria and the production of dendritic keratitis by inoculation of the cornea from labial herpes are discussed. These experimental animals have also developed paralysis, convulsions, etc., which Doerr has demonstrated to be encephalitis, and he believes this virus to be practically identical with that of epidemic encephalitis. The therapy for dendritic keratitis is discussed, especially phototherapy. Six cases are reported, in four of which phototherapy was used with rather indifferent results.

W. S. REESE.

FILAMENTOUS KERATITIS. S. P. CHANG, Nat. M. J. China **15:** 600 (Oct.) 1929.

This rare condition has not hitherto been reported in China. The etiology is obscure. Recently, Houwer published a paper in which he emphasized the connection of filamentous keratitis with chronic arthritis. Chang mentions ten cases, all of which were bilateral, and with remissions and exacerbations extended over a period of years. The details of a case are given which occurred with mild and uncomplicated trachoma, and old phlyctenular keratitis in a woman, aged 22, who had been suffering from chronic arthritis for over a year.

S. H. MCKEE.

Lens

SOME POINTS IN CONNECTION WITH CATARACT EXTRACTION. R. H. ELLIOT, Brit. M. J. **2:** 1147 (Dec. 21) 1929.

Elliot takes up certain points in the cataract operation to explain his personal views. The time of operation should be decided after a careful consideration of all the factors in each individual case. The writer does not share the frequent statement that the cataract should not be operated on as long as the second eye sees well. Though the aphakic eye cannot be fitted with glasses, it is of great use in avoiding personal injury. Age is an important factor in the success of a cataract operation; it is therefore not wise to wait indefinitely before operating. In this connection, it is more important to consider the patient's actual state of health than the number of years he has lived. A patient should not be allowed to drop his normal activities. An immature cataract can be operated on at any time, with good prospects of success. The dangers

of hypermaturity are definite, and in the author's large experience in India consist in secondary glaucoma and a slow form of iritis. The type of cataract in which secondary glaucoma is most to be feared is the one in which swelling takes place as the result of imbibition of fluid. Those cataracts have a white, shiny appearance with mother of pearl (asbestos-sheen, H. Knapp) sectors, and the anterior chamber is shallow. A brown lens with shallow anterior chamber is not necessarily above suspicion. It is better for the morale of the patient to be operated on when there is still some sight in the other eye. If the first eye has been successfully operated on, the second should be operated on because of the morale, as the first eye may be lost from a number of unavoidable causes. Two eyes are always better than one, and a blind eye on one side is always a danger. Coloration of vision is annoying, and disappears only after the second cataract operation.

As to the method of operating, the safest possible routine is essential; hence dental foci of infection and other forms of autointoxication must be avoided; the conjunctiva must be healthy and a preliminary iridectomy must be done; one month later the cataract can be extracted under a conjunctival bridge. Though this bridge adds to the difficulty of delivering the lens, it ensures a smooth after-course. Any after-cataract can be dealt with six weeks later. In the after-treatment, the remaining eye can be used as soon as possible, as long as no pain or discomfort ensues.

General conditions like diabetes are not a contraindication as long as diacetic acid and acetone are absent from the urine. "Human sympathy" will dictate how the patient with cataract is to be told of his affliction, the surgeon remembering that there are many forms of cataract which vary in their degree of progression. As for promises of results from operation, the patient must be told that in the operation for cataract, promises are impossible, and the most the surgeon can do is to state the probabilities.

During the development of the cataract Elliot gives his patient the utmost freedom, as the ordinary use of the eye is not prejudicial. The only remedy which he seems to think exerts any restraining influence on the development of the cataract has been the exhibition of thyroid gland in suitable cases.

As a rule, a month is long enough for the eye to recover from the operation, and the eye must be shielded against chills, and especially from those due to winds.

A. KNAPP.

INTRACAPSULAR CATARACT EXTRACTION ACCORDING TO THE STANCULEANU-TÖRÖK-ELSCHNIG METHOD. K. SAFAR, Ztschr. f. Augenh. **69:** 147 (Sept.) 1929.

Safar describes in detail the procedure which he calls the Stanculeanu-Török-Elschnig operation for intracapsular cataract and gives a résumé of fifty operations which he performed according to this technic. From his results and those reported by others employing this method, he concludes that the operation for intracapsular cataract performed in accordance with this technic gives better results than any of the extracapsular operations. He notes that the intracapsular operation is not suitable for the extraction of cataract in young people. This method

is best adapted to immature senile cataracts in which tumefaction has not set in, and may be employed in the removal of ripe or almost ripe cataracts. It is a difficult procedure and requires considerable sureness and practical experience on the part of the operator. The preparation must be exact, and good assistance during the operation is required. The technic is difficult to master and is more complicated than that of the extracapsular extraction. The loss of vitreous and prolapse of the iris are hardly more frequent in this operation than in a similarly prepared and carefully executed extracapsular operation. The delivery of the lens is complicated in those cases in which the capsule tears before the lens is completely luxated. This method of extraction is difficult to employ when the lens tissue is swollen, for the blunt forceps ordinarily used cannot be applied to the capsule without rupturing it.

The outstanding advantages of this method are as follows: A complete separation of the lens in its capsule is obtained, with avoidance of subsequent operations on secondary membranes that frequently form following the extracapsular extraction; postoperative iritis, as a rule, is absent; secondary infection is minimized, and absorption of operative hyphemia is more rapid. The percentage of better visual acuity is greater following the extracapsular method. Safar found this method more advantageous than that advocated by Barraquer or Smith.

A. M. YUDKIN.

Uvea

RECURRING HYPOPYON-IRITIS AND ITS RELATION TO TUBERCULOSIS. J. URBANEK, Ztschr. f. Augenh. **69:** 174 (Sept.) 1929.

In 1906, Reis described the iritic manifestation of a recurring hypopyon-iritis as an endogenous iridocyclitis. The outstanding symptom of this disturbance was a periodic appearance of a hypopyon in the anterior chamber, which completely vanished in a few days only to return again. After each attack the visual acuity was diminished. Urbanek observed two such cases and reports the progress, the examination and the treatment in detail. He notes that no definite focus of infection was found in either case until the patient was treated with a gold protein-containing preparation. Following this therapy, a definite tuberculous lesion was discovered in the nasal mucous membrane. By further treatment with this medication, the interval between the attacks was lengthened and the ocular and the nasal tissue showed marked improvement. The visual acuity was also improved in the patients treated. From his vast experience with tuberculous ocular disturbances and the response of this lesion in the two patients whom he studied, he concludes that the etiologic factor in recurring hypopyon-iritis must be a tuberculous one.

A. M. YUDKIN.

Glaucoma

GLAUCOMA WITH NEGATIVE ETIOLOGIC DATA (NEGATIVE GLAUCOMA PATIENTS). C. ESPÍLDORA LUQUE, Arch. de oft. hisp. am. **30:** 594 (Oct.) 1929.

This is the fifth and final paper on general lesions found in patients with glaucoma. The author classifies this final group as "negative

glaucoma patients." It includes those cases in which the usual methods of investigation have not brought out the slightest organic lesion and in which the only pathologic manifestation was the eye lesion.

Of the 300 cases forming the basis of these papers, only 27 were found in this group, constituting only 9 per cent of the total number of cases. In relation to the different age groups, 12 per cent belonged to the juvenile, 11 per cent to the mature and presenile and 6 per cent to the senile groups.

The general examination carried out in these cases consisted of a careful clinical examination of all the organs and mechanisms, especially of the cardiovascular system, including sphygmomanometry and sphygmography, urinalysis, quantitative determination of blood urea, Wassermann tests before and often after reactivation—in some cases the spinal fluid being independently examined—combined with a careful study of the patient's history.

In five of these cases, although no organic lesion was found, the patients stated that their glaucomatous attacks had occurred during an acute febrile disturbance, diagnosed by the attending physicians as grip in four cases and as typhus fever in one. In all these cases, the glaucoma was of a violent bilateral type; in two fulminating cases, blindness was produced within a few hours, and in the other three, the primary acute attack was followed by a chronic process, which did not lead to a complete blindness. In the case occurring during typhus fever, apart from the classic excavation, disseminate foci of equatorial choroiditis were determined, indicating a lesion of the uveal vessels.

These cases of ocular hypertension with an acute infectious or toxic origin differ from those observed in syphilitic, arteriosclerotic and other generally diseased patients. In the latter, the etiologic factor persists indefinitely with time enough to attack different vulnerable organs, hence the frequency of vascular lesions. In the former, the etiologic factor acts only for a few days, although often in a violent and brutal form, and is unable to produce permanent lesions, which require slow and prolonged action; it attacks only certain organs and tissues which offer less resistance or special conditions of receptivity.

The author doubts that these cases really constitute an exception and suggests the possibility of their presenting in the future general lesions, which at the time of the examination may not be manifest. In support of this point of view, he refers to one of Charlin's cases of chronic glaucoma, in which at the time of the first examination the results of all general examinations were negative, while in successive examinations, from three to nine years later, gradually developing vascular lesions were found. He next refers to several other similar cases.

General Conclusions.—From the subjects discussed in the whole series of papers, the author concludes that primary glaucoma should be included in the group of eye diseases which originate from a general disturbance, of which the ocular increase in tension is only one symptom.

The majority of patients of all ages with glaucoma are found to present localized cardiovascular lesions, which occur in 68 per cent of the juvenile, in 78 per cent of the mature and presenile and in 88 per cent of the senile groups. The most frequent lesion was aortitis, found in 44 per cent of the juvenile cases, being always of syphilitic origin,

and in 63 per cent of the mature and senile cases. Arterial hypertension was found in 52 per cent of the cases, 32 per cent belonging to the juvenile, 53 per cent to the mature and presenile and 71 per cent to the senile groups, being mostly accompanied by aortitis and arteriosclerosis, and exceptionally by a nephritis. Renal disease was found in only 15 per cent of the cases and was limited exclusively to patients with a low Ambard constant. Only 9 per cent of the cases were free from vascular disease. Glaucoma often leads to a diagnosis of syphilis. It is difficult to establish a direct relation, probably it is indirect, owing to the production of vascular lesions in syphilis.

The author considers finally that glaucoma, in most patients, is only an ocular manifestation of a general vascular syndrome and should be considered as an ocular lesion indicative of a present or future general arterial lesion.

C. E. FINLAY.

Retina; Optic Nerve

TEMPORARY BLINDNESS FROM RETINAL ANGIOSPASM OF MALARIAL ORIGIN. J. SÉDAN, Ann. d'ocul. **166:** 705 (Sept.) 1929.

A patient who became temporarily blind during an attack of malaria was studied by the author, and the observations reported. A history of malaria of long standing was present, during which periodic doses of quinine were taken, but just previous to the attack of blindness the patient had abstained from treatment for a month.

The onset was preceded by severe headaches, chills and fevers. Objects then appeared dim, followed by rapid loss of vision until the patient became blind, a condition which lasted three days.

Mydriasis with slight inequality of the pupils was present, and the patient complained of tight constrictions behind the eyeballs.

The eyegrounds showed a general retinal ischemia; the arteries were entirely empty, giving the appearance of fine, slightly undulating silk threads, while the vein seemed, in comparison, to be dilated. The disk appeared slightly less colored than normally, with blurred edges. There was also an associated hypotonus which, according to Bailliart, is often seen in retinal angiospasm. The fields were greatly constricted.

Amyl nitrite failed to affect the spasm, while quinine was soon followed by improvement.

H. W. SCARLETT.

TWO CASES OF SPASM OF THE CENTRAL ARTERY OF THE RETINA. A. FIFAT, Ann. d'ocul. **166:** 711 (Sept.) 1929.

Until a few years ago, when Abadie published his work, angiospasm of the retinal arteries and embolism were frequently confounded.

In embolism, failure of sight is complete, while in angiospasm perception of light remains. The photometer reflex is abolished in embolism, but persists in angiospasm. Also, in angiospasm, retrobulbar injection of 1 mg. of atropine can cause a prompt dilatation of the retinal vessels, which is a point of differential diagnosis.

Two cases are reported in detail, with a description of the changes in the fundus, showing a pale disk with blurred edges, constricted ves-

sels and a patch of retinal edema in the second case. The fields were contracted.

In both instances, injections of 1 mg. of atropine sulphate were given deep into the orbit, following which the vessels immediately dilated and the vision returned to normal in one case, and 8/10 in the other.

Patients with persistent retinal angiospasm should be treated energetically by antispasmodics, such as the retrobulbar injections of atropine.

H. W. SCARLETT.

THE ANATOMY OF FRESH RETINAL DETACHMENT. R. KÜMMELL, Arch. f. Augenh. **100-101:** 314, 1929.

The author reports the microscopic observations in an eye that was removed seven days after the beginning of a retinal detachment. This is the earliest case on record in which the detailed microscopic observations are given. The eye was removed because of a suspicion of tumor. The only marked changes in the eye were those affecting the retina and particularly the anterior segment of the retina.

These changes consisted of cystic degeneration. In parts, this led to an almost total destruction of the retinal structure, so that here and there it consisted only of strands of connective tissue. Around the edges of two tears, this degeneration was most marked. The author mentions Hanssen as showing that a fair proportion of myopic eyes examined histologically show similar cystic degeneration. He does not believe, however, that this change in the retina has been the cause of the detachment, since three other cases of detachment examined histologically showed none of the changes. No strands of connective tissue or changes in the vitreous could be found in this case which could account for the detachment, and no tumor was found.

The author concludes that simple detachments of this type are due to changes in the pressure in the posterior chamber similar to those described by Baurmann. In nearly all of the cases which he has examined, the intra-ocular pressure was considerably reduced. This reduction of intra-ocular pressure allows a dilatation of vessels in the retroretinal space with a transudation of fluid. This space which is normally a capillary slit due to the greater pressure in front of the retina is now forced open and the retina detached.

F. H. ADLER.

DISEASE OF THE OPTIC NERVE IN MALIGNANT SCLEROSIS. J. IGERSCHEIMER, Ztschr. f. Augenh. **69:47**, 1929.

Igersheimer describes the protocol of a case in which the visual acuity diminished gradually almost to blindness within one month. Necropsy disclosed a general arteriosclerosis of the arterial bed. With this case as his theme, he postulates the etiology of similar disturbances of the optic nerve, particularly that condition frequently labeled optic neuritis. He shows that the fundus picture is often the result of a deficiency of tissue (optic nerve) metabolism produced by an alteration of the vascular system of the structure in question. He does not believe that the alteration of the nerve fiber is due to a toxin in the blood.

A. M. YUDKIN.

RETINITIS PIGMENTOSA AND ABNORMAL COURSE OF THE LONG CILIARY ARTERIES. HOLGER EHLERS, Acta ophth. **7**:321, 1929.

Ehlers found an abnormal distribution of the long ciliary arteries in the eyes of an epileptic brother and sister who suffered from retinitis pigmentosa. He cites several opinions concerning the abnormality of ciliary arteries and also the theories advanced for the retinal disturbances known as retinitis pigmentosa. He assumes that the disturbance in the circulation of the choroid is most likely responsible for retinal pigment degeneration and that its suggests a causal relation between retinitis pigmentosa and the familial abnormality of the long ciliary arteries which he found. He states, however, that this assumption does not elucidate the pathogenesis of retinitis pigmentosa in all its details.

A. M. YUDKIN.

Neurology

PUNCTURE ACCORDING TO ANTON AND SCHMIEDEN'S METHOD IN A CASE OF INTRACEREBRAL HYPERTENSION. NAGY, Rev. de chir., 1929, no. 8.

In a case of hydrocephalus and intracerebral hypertension due to obstruction of the foramen of Magendie resulting in blockage of the communication between the intracranial and the intraspinal fluid of the subarachnoid spaces, the author recommends the puncture of Schmieden as it is apt to restore the communication. As long ago as 1908, a similar subcerebellar puncture was advocated and carried out by Obreja. He did not, however, transfix the membrana tectoria; he transfixed the membrana cerebellomedullaris which covers the subarachnoid cistern and the subcerebellar space. This subcerebellar puncture lends itself perfectly to diagnostic and therapeutic purposes; its technic is simple, but it requires, of course, skill and caution.

N. BLATT.

BLOOD VESSELS OF THE RETINA IN FEEBLEMINDED CHILDREN. H. GAUSS, Arch. f. Psychiat. **88:** 776 (Nov. 25) 1929.

On the basis of a study of 122 feebleminded children between the ages of 5 and 15 (sixty-nine boys and fifty-three girls), Gauss reports that he could not find a fundamental difference in the course of the blood vessels in these as compared with a normal group. The variations in 25 per cent of feebleminded children and in 30 per cent of normal children are within physiologic limits, and Jaench's statements cannot be given support. Disorders of the eye, however, such as pseudoneuritis, strabismus, malformations (displacement of the pupil and coloboma of the choroid) and loss of color of the iris, were observed as frequently as by other authors.

W. ZENTMAYER.

AN ANATOMIC FOUNDATION FOR OPHTHALMOPLEGIA INTERNA. GEORGE LENZ, Ztschr. f. Augenh. **69:** 101 (Sept.) 1929.

From a study of histopathologic sections of the brain tissue removed from a patient having a clinical picture of ophthalmoplegia interna, Lenz believes that the primary lesion is in the frontal area of the main

nucleus of the oculomotor nerve. The frontal area represents the sphincter nucleus, and damage to this area is responsible for the loss of pupillary reaction for light, convergence and lid-closing. A destruction involving this area with an overlapping of the lesion into the adjacent half of the medium nucleus will produce ophthalmoplegia interna. He finds that in tabes, ophthalmoplegia is also found. This investigation reveals that the anterior area of the oculomotor nucleus is proof of syphilitic involvement and that probably 80 per cent of all cases of ophthalmoplegia interna are due to a syphilitic infection.

A. M. YUDKIN.

Ocular Muscles

OPHTHALMOPLEGIC MIGRAINE. R. P. MACKAY, Am. J. Ophth. **12:** 889 (Nov.) 1929.

A case report is given of a man, aged 28, who had had about eight attacks of ophthalmoplegic migraine during the ten years previous to examination. There was a complete third nerve palsy with very slight weakness of the right side of the face, and a reduction of vision even as far as to the counting of fingers.

Transient focal signs and symptoms suggesting a localization of the cerebral process occur in ophthalmoplegic migraine. These may be divided into sensory, motor and psychic. In the sensory group, hypesthesia, hyperesthesia or paresthesia of part of the face or lips, or of an arm or leg may occur. Hemihypesthesia has been reported. Crude visual hallucinations are common, and formed visual hallucinations have been observed. Homonymous field defects are frequent. The vision of the affected eye is usually poor, and dizziness, probably of visual origin, is common. One case with an olfactory prodrome has been reported, and another with transient nerve deafness. In the motor group transient paralysis is common, such as hemiplegia and monoplegia of the arm or leg, and facial palsy, which when right sided may be accompanied by aphasia. A case of paroxysmal cerebellar ataxia has been reported. Of these palsies the most frequent is oculomotor paralysis. The various characteristics of these palsies are discussed, and also the possible causes of opthalmoplegic migraine. The author is inclined to the belief that some vasomotor or edematous condition is responsible.

W. S. REESE.

OCULAR PARALYSIS FOLLOWING LUMBAR ANESTHESIA. DR. NIKOLAUS BLATT, Wien. med. Wchnschr. **79:** 1391 (Oct. 26) 1929.

The author reviews the previously reported cases of paralysis after lumbar anesthesia. He reported two cases in 1918 and now reports three additional ones, bringing the total of reported cases in the literature to ninety-seven.

In his first case, a pelvic repair was performed under lumbar anesthesia with procaine hydrochloride. The patient, who was of a hysterical temperament and had had epileptic attacks in childhood, suffered with severe headaches and slight spasms and delirium following the

operation. Five days after the operation, double vision appeared, due to a left-sided abducens paresis. After five months, this had improved somewhat but it did not disappear until nine months after the operation.

His second case concerned a patient with a similar nervous constitution. Tropacocaine was used for lumbar anesthesia for a slight rectal operation. Double vision occurred on the sixth day after operation, and in this case both the abducens and the trochlearis of the right eye were involved, the paralysis lasting ten weeks.

The third case, the details of which were communicated to the author by Hirsch, was a similar one in which tropacocaine was used and in which abducens paresis occurred, which cleared up after several months. The author believes that the paralysis was due to chemical changes in the cerebrospinal fluid caused by and resulting in a toxic effect on the nerves. The predilection for the abducens is not explained. He believes that the presence of the neuropathic constitution in his patients was an important predisposing cause for the paralysis and advises a careful neurologic examination before the employment of lumbar anesthesia, which should not be used in the presence of such a constitution.

S. R. GIFFORD.

CONGENITAL UNILATERAL GRAEFE'S SIGN IN FACIAL MYOPATHY: MECHANISM OF GRAEFE'S SIGN. J. STRBEL, Schweiz. med. Wchnschr. **59:** 906 (Sept. 7) 1929.

Strebel describes the case of a man with congenital unilateral facial myopathy in whom Graefe's sign was noted. The pathologic conditions in this case and in a case of exophthalmic goiter illustrate the mechanism of Graefe's sign. If the orbicularis is paretic, or if the action of this muscle is hindered by an exophthalmos, the levator palpebrae superioris will exert a stronger influence than the orbicularis and so produce the condition that is known as Graefe's sign. In short, this symptom is the result of an insufficiency of the orbicularis.

W. ZENTMAYER.

Orbit, Eyeball and Accessory Sinuses

A LENTOID PROCESS IN A HUMAN MICROPHTHALMUS. FRANZ FISCHER, Ztschr. f. Augenh. **69:**30, 1929.

Fischer describes the presence of a lentoid process in a microphthalmic eye which was removed from a child, aged 15 years. His interpretation of this observation is unusual. He describes the specimen in detail and concludes that the so-called lentoid process which seems to originate from the ciliary epithelium resembles a similar process found in the amphibia. This assumption would lead one to believe that the cells of the ciliary epithelium in the human eye have the power to regenerate lenticular cellular tissue.

A. M. YUDKIN.

MICROPHTHALMUS WITH HIGH DEGREE OF MYOPIA. H. T. PI, Nat. M. J. China **15:** 626 (Oct.) 1929.

Microphthalmus varies in degree considerably from eyes that are a mere rudiment to those of almost normal size, and is often associated

with other malformations in the eyeball itself, as well as in other parts of the body. Hyperopia is almost invariably met with in microphthalmus. The case here reported represents the type in which the cornea of one eye falls just within the upper microphthalmic limit of measurement (corneal diameter from 9 to 9.5 mm.), while the other shows extreme microphthalmus. Vision of the right eye corrected with a —24 sphere, with a —1.50 cylinder axis 10 was equal to 6/15. The left eye showed amaurosis. The details of examination are given, with two illustrations, one showing the extreme microphthalmus of the left eye, the other a picture of the fundus.

S. H. McKee.

General Diseases

The Retinal Blood Vessels in Hypertension and Arteriosclerosis. Harry Friedenwald and Jonas S. Friedenwald, Bull. Johns Hopkins Hosp. **45**:232 (Oct.) 1929.

The authors present the result of their studies, protracted over a number of years, in which they have attempted to analyze and correlate the ophthalmoscopic and clinical observations in about 2,000 cases in the medical wards of various hospitals. They were unable to confirm the widely held belief that arteriovenous compression is a sign of hypertension. Severe grades of arteriovenous compression were found in cases of arteriosclerosis, both with and without hypertension, while mild grades of arteriovenous compression were often found in normal persons. The brightness of the arterial reflex was also not found to be constantly related to increased blood pressure, but was found to be related most directly to the diameter of the vessels.

Special attention was given to the problem as to whether arteriosclerosis precedes or follows hypertension, but the authors found that the material was inadequate to enable them to give a definite answer to this question. Advanced cases of hypertensive disease almost always showed retinal vascular lesions, while early and mild cases almost always showed normal fundi. In general, therefore, retinal arteriosclerosis was found to follow hypertension. However, cases of long standing and severe hypertension were found without any retinal vascular lesions; in many cases the severity of the retinal lesions could not be clearly related to the duration and severity of the associated hypertension. Also many cases of severe retinal arteriosclerosis were found in patients with normal blood pressure. In the latter, some of the patients were believed to be suffering from chronic arterial hypertension in which the blood pressure had temporarily fallen to normal because of some intercurrent disease. Other patients were thought to have pure arteriosclerosis, and showed no clinical evidence of ever having had hypertension. The further analysis of these contradictions led to a classification of the cases which is summarized in the accompanying table.

The authors emphasize the necessity of examining the smallest visible retinal arterioles with special care. In cases of hypertensive disease of the most severe and malignant form, they found these arterioles to be the first and often the only retinal vessels showing clearly recognizable lesions.

J. S. Friedenwald.

Clinical Type	Comment	Dominant Features in Eyeground	Accessory Eyeground Observations	Exceptions	
				A. Clinical Features Present with Absent or Atypical Eyeground Observations	B. Typical Eyegrounds with Atypical Clinical Observations
I. Hypertension without retinal arteriosclerosis	Acute nephritis, essential hypertension, *Stauungshypertonie*, pregnancy, brain tumor, hyperthyroidism, etc.	Normal; or slight arteriovenous compression	Slight edema of retina sometimes seen in acute nephritis	a. Cases of toxemia of pregnancy with eyeground picture of albuminuric retinitis b. Similar rare cases of acute nephritis	Mild grades of arteriovenous compression often found in healthy young persons
II. Retinal arteriolarsclerosis	Especially in rapidly progressing chronic nephritis. The eyegrounds reveal no distinctions between arteriolar sclerotic nephritis and chronic glomerulonephritis	Larger vessels full and tortuous. Arteriovenous compression. Irregular tortuosity, caliber variations, visibility of the walls of small macular arterioles and of those in periphery of fundus. Fig. 1, Section D	Typical picture of albuminuric retinitis is often seen in these cases. In late stages larger arteries also show sclerotic changes	a. Cases of rapidly progressing chronic nephritis with predominant arterial rather than arteriolar retinal lesion, most often seen in women b. Arteriolar changes sometimes not visible in macula in albuminuric retinitis on account of edema, but visible in periphery of fundus	Cases of retinal arteriolar sclerosis sometimes seen before development of renal signs
III. Retinal arteriosclerosis with hypertension	Especially in elderly persons, but seen also at times in younger people. Prognosis worse in younger persons. Renal damage is quite variable, often slight	Diffuse constriction of larger arteries with fine caliber variations, arteriovenous compression, disappearance of reflex stripe. Fig. 1, Section C	Visible thickening of walls of arteries and veins. Thrombosis of large branches. Scattered hemorrhages and exudates. Choroidal arteriosclerosis	Early and mild cases sometimes fail to show arterial constriction	Typical eyeground observations with low or normal blood pressure. These cases reveal with a high degree of uniformity some cause for low blood pressure, such as cardiac failure, malignancy or other intercurrent disease
IV. Retinal arteriosclerosis without hypertension	Senile cases. No cardiac hypertrophy	Differ from group III in that the larger vessels are of normal caliber. Arterioles normal. Fig. 1, Section B	Beading of larger vessels, irregularity in light streak, visible walls, arteriovenous compression (rare); hemorrhages, exudates (scattered); choroidal arteriosclerosis		In young and middle-aged persons the same picture is usually associated with hypertension. As these cases progress the picture usually changes to that noted in group II or III
V. Syphilitic arteriosclerosis	Sometimes seen in syphilis of central nervous system, almost never in tabes or paresis	Lesions when present are at times widely scattered, some vessels appear normal, others markedly sclerotic			
VI. Retinal arteriosclerosis resulting from local disease	Optic atrophy, glaucoma, retinitis pigmentosa, local inflammatory disease, etc.	Extreme narrowing of arteries *and veins*, caliber variations, visible walls. Arteriovenous compression (rare)	Perivascular scarring from the organization of inflammatory exudates		When general arteriosclerosis is present in addition, it is often difficult to evaluate how much of the retinal vascular lesion is due to antecedent local cause and how much to constitutional factors

A Case of Cysticercus of the Brain. Jianu, Lazarescu and Popescu, Rev. de chir. (no. 3) 1929.

The authors report a case of injury of the skull, which occurred two years ago, with immediate appearance of convulsive fits. There was a linear scar 5 cm. long in the right frontoparietal region. Neurologic examination disclosed: frontotemporal headache, giddiness, temporary anesthesia of the left hand and paresthesia of the right hand (slow and tonic convulsive movements of the right hand). Each convulsion ended in the patient losing consciousness and falling to the floor. Complete amnesia ensued. The fits lasted for about from fifteen to twenty minutes. The fits returned again approximately every two months. It would seem, therefore, that these convulsions are to be identified as jacksonian. Craniectomy was performed under procaine hydrochloride-morphine anesthesia at the level of the injured area of the skull. Clinically and histologically, it was then possible to establish the diagnosis of cysticercus of the cortex. Recovery was complete three weeks after the operation.

N. Blatt.

A Case of Myeloic Leukemia with Bilateral Choked Disk. P. A. Jaensch, Arch. f. Ophth. 122: 618 (Aug.) 1929.

A boy, aged 9, showed the typical clinical picture of myeloic leukemia. Then he suddenly developed symptoms of increased intracranial pressure (vomiting, headache, choked disk). These symptoms grew worse, and a trephination was done. One day after the operation, the boy died. The eyes showed anatomically a marked venous stasis, marked edema of the septums of the optic nerve and a typical choked disk with hemorrhages and retinitic spots, without any inflammatory symptoms. The author thinks that in his case the choking was due to the increased pressure and the abnormal condition of the blood.

P. Kronfeld.

The Efficacy of the Epithelium of the Ciliary Body in the Absorption of Vitreous Hemorrhages. J. Meller, Ztschr. f. Augenh. **69:** 113 (Sept.) 1929.

Meller describes the histopathology of a ruptured eye in which the unpigmented cells in the flat part of the ciliary body showed the presence of absorbed blood and the waste products of blood. In some sections of the tissue, the cells appeared normal; in others, they were elongated and the outlines were curved as if to engulf some foreign object, and in places many strands of cells were separated from the rest of the tissue as if raised by fluid. This last observation has been interpreted by E. Fuch as an edema of the epithelial layer of the ciliary body, but Meller contends that this interpretation is not justified, for the whole picture may be explained on the basis of cellular activity on the part of this epithelial tissue in the absorption of fluids from the surrounding media. This interpretation is in accord with his previous theory of phagocytosis of the epithelial cells of the ciliary body.

A. M. Yudkin.

THE MAIN SYMPTOMS OF THE EYE IN VITAMIN A DEFICIENCY IN ADULTS. A. PILLAT, Nat. M. J. China **15:** 614 (Oct.) 1929.

In this article, the well known symptoms due to deficiency of vitamin A in food are noted and enlarged on in a varying degree. They are night blindness, xerosis epithelialis conjunctivae, which is usually the second stage of vitamin A deficiency; Bitot's spots, which are triangular white spots appearing like a dense foam of soap in the palpebral fissure region, with the base at the limbus. They usually first appear at the temporal side of the cornea, and later at the nasal side. In healing, they break up into different islands, and the tiny dry spots finally disappear, leaving a zone in the conjunctiva which is often stippled by fine superficial defects in the epithelium, seen only with the slit-lamp. Irregular xerosis of large parts and loss of luster of the bulbar conjunctiva and wrinkling of the conjunctiva are noted. Xerosis epithelialis corneae, while often associated with the various types of xerosis of the conjunctiva, may occur alone in rare cases. The writer divides the condition clinically into the prexerosis and the real white xerosis of the cornea. Keratomalacia is frequently seen. Pigmentation of the conjunctiva is most marked in the region of the semilunar fold and caruncle, and from here extends first to the fornices and then to the bulbar and lid conjunctiva. Histologically, the pigment was found chiefly in the basal cell layer of the epithelium. Meibomitis, blepharitis and hordeolum, decrease of tear fluid, edema, puffiness of the lids and comedones are also found in this deficiency condition.

S. H. MCKEE.

OCULAR OBSERVATIONS IN SOME INFECTIOUS DISEASES (TYPHUS, TYPHOID, DYSENTERY, KALA-AZAR AND PELLAGRA). W. P. LING, Nat. M. J. China **15:** 632 (Oct.) 1929.

This article consists in a critical review of some of the literature on the subject, with some special observations made among the Chinese, with an appeal for a more extensive investigation along these lines. Ocular complications of various kinds have been reported in the literature in connection with the aforementioned diseases. These observations have been made in different localities by different authors at different times, and many of them should not be considered as final. Then follows a critical review of the subject, with the author's hope that a more extensive and useful investigation of the subject will be undertaken immediately. Quite a large bibliography closes the article.

S. H. MCKEE.

Society Transactions

EDITED BY DR. GEORGE S. DERBY

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

W. F. C. STEINBUGLER, M.D., *Secretary*

Dec. 16, 1929

ERNEST F. KRUG, M.D., *Chairman*

IMPLANTATION CYSTS AND MYOPIC CRESCENTS WITH ASSOCIATED CHORIOVAGINAL VEINS. DR. LOUISE H. MEEKER.

Implantation Cysts.—Cysts formed within the eye by the implantation of corneal epithelium are well known. It is necessary to distinguish between ingrowths of epithelium and true implantations. If it is shown by serial sections that the cyst lining is not continuous with the corneal wound, it is evident that one is dealing with implantation cysts. They are commonly found in the cornea, anterior or posterior chambers, or iris. The two examples shown in the slides have rarely been seen. The first is in the lens capsule and followed the extraction of a cataract. The collapsed capsule is lined by typical corneal epithelium. Wintersteiner recorded a similar case. Such observations are scarce in the later literature.

The second followed an accidental wound of the cornea. Two entirely separate cysts are shown, one in the iris and a second one in the ciliary body. The cyst in the iris is beneath the pigment epithelium. The larger cyst measured 8 mm. in diameter and lay in the suprachorioidea, its outer wall against the sclera. There is no similar case in the literature.

Myopic Crescents with Associated Choriovaginal Veins.—Myopic crescents are commonly divided into acquired and congenital types. The congenital crescents must present developmental anomalies such as, deformities of the retinal layers, the pigment epithelium, the lamina vitrea, sclera and optic nerve canal. A defect in a single ocular tunic is enough to establish a diagnosis of coloboma or congenital crescent as admitted by most authorities, notably Elschnig. Ectasia of the sclera is not necessary. Crescents found on the nasal side or above the disk are called atypical. Fuchs' coloboma or inferior conus is fairly common, and many anatomic studies have been made. Few anatomic studies have been made of the atypical crescents, and for this reason we present the following two examples.

The first example is found in a blind eye enucleated four weeks after an accident. The anteroposterior diameter of the eye is 26 mm. On the temporal side of the papilla there is a defect in the retina, pigment epithelium, lamina vitrea, choroid and scleral ring measuring 0.5 mm. at the point of greatest width. The optic nerve spreads laterally into the defect. A very large vein in the pia on the temporal side extends from the inner end of the intervaginal space backward and receives branches from the posterior ciliary vessels. This is a typical choriovaginal vein.

Schoute first described this vein. He had seen the eye thirteen years before enucleation, and in his clinical notes had recorded a visible hemorrhage in the optic nerve sheath. Oeller has said that the presence of this vein is alone enough to establish the congenital nature of an associated crescent.

The second example is also found in a blind eye. There is a history of iridectomy and later trephine with following iridocyclitis. The anteroposterior diameter is 28 mm. There is a circumpapillary defect in the lamina vitrea with an optic nerve canal measuring two and one-half disk diameters. There is an equally wide defect in the pigment epithelium, choroid and sclera, especially marked on the nasal side. The intervaginal space on the nasal side spreads laterally as far as the defect in the choroid and the lamina vitrea on this side dips backward and disappears in part. The optic nerve bundles spread into the defects in the ocular tunics. A large vein on the nasal side can be traced from the outer border of the intervaginal space backward in the sclera to the pial sheath where it extends backward and toward the central vein. It receives branches from the posterior ciliary vessels. This is also a typical choriovaginal vein.

Anatomic studies of choriovaginal veins are few. Fuchs, in 1923, presented four examples in a series of vessel anomalies most of which concerned arteries. Coats' classic example illustrates anastomosis with trabecular vessels. Our two examples are the only other illustrations we have found.

We consider the crescents in both eyes congenital defects or colobomas. The choriovaginal veins help to establish the diagnosis but are not necessary. The two examples presented add something to the previous anatomic studies that have been made of atypical crescents and choriovaginal veins.

We are indebted to Dr. Cohen and Dr. Troncoso for the privilege of showing these eyes.

DISCUSSION

DR. MANUEL URIBE TRONCOSO: The second case to which Dr. Meeker referred was that of a patient in my clinic at the Post-Graduate Hospital, and I want to give some additional information to the section in order that the anatomopathologic observations can be correlated with the clinical picture. When I saw the patient for the first time, she was blind in the right eye after being operated on for glaucoma; in fact, she was in the stage of absolute glaucoma after having an iridectomy and then a trephining. The eye was inflamed and very painful, and I decided to do an enucleation. Of course, the fundus could not be observed in this eye, but in the other the ophthalmoscopic examination was very interesting. There was a high degree of myopia, about 15 diopters. The lens was clear. In the fundus all around the optic nerve appeared a large, round, white area with clearcut margins, about one or one and one-half disk diameters in width, which was diagnosed as a circumpapillary atrophy of the choroid in myopia. There was no excavation in the disk in the central or lower part; no coloboma of the choroid in the lower fundus and no signs of glaucoma. Of course, we cannot with certainty apply the clinical observations on the left eye to the condition of the blind right eye, but it is highly probable that if there was a congenital condition it was bilateral. From the clinical standpoint, it was very difficult to correlate the white circumpapillary area with a coloboma

of the optic nerve. We always associate colobomas of the optic nerve proper, or of the optic nerve sheaths, with a wide depression, or some kind of excavation in the disk. In coloboma of the optic nerve proper, there is an enlarged optic nerve and a deep excavation and the vessels bend sharply at the edge of the coloboma or sometimes further in. It is difficult in some cases to make the diagnosis between this condition and the excavation of a chronic glaucoma. That was not the case with this patient; the vessels came to the center of the disk, and there was no kinking. In the other kind, the coloboma of the optic nerve sheaths, the disk stays in the center or is drawn toward the upper part of the enlarged fetal cleft. There is a kinking of the vessels especially at the lower part of the disk. As Dr. Meeker's pathologic examination of the right eye shows conclusively the existence of a coloboma of slight degree, with enlargement of the choroidoscleral canal, we must revise our knowledge of colobomas in its relation to the fundus picture, in the light of the pathologic changes which Dr. Meeker has shown. From the standpoint of excavation, we must remember that in the inferior conus, or Fuchs' coloboma, there is no excavation in the disk, and still it has been classified as a coloboma. The other interesting point in both of Dr. Meeker's cases is the presence of choriovaginal veins, which are always associated with some other structural defects. From the clinical standpoint, choriovaginal veins are usually seen as posterior vortex veins. They are found around and outside the optic nerve, and they receive numerous branches. Other times they form a vortex inside of a myopic crescent at the border of the disk. In my patient, the other eye did not show any posterior vortex veins. The choriovaginal veins were probably covered by the pigment epithelium, and could not be observed in their origin, nor behind the lamina cribrosa.

AIDS TO OPHTHALMOSCOPY. DR. ALGERNON B. REESE.

Dr. Reese presented a device on an ophthalmoscope whereby the disk containing the lenses can be returned to the aperture without the physician's looking at the instrument. This enables one to forego the necessity of turning on a light in the dark room in order to place the instrument at zero, and for the same purpose it is also of convenience to those who need their presbyopic correction.

The attention of the section was also called to the fact that one is able to see with an ophthalmoscope further into the periphery of the fundus by the aid of a 20 degree prism. The prism is held close to the patient's eye with the base directed in the direction of the periphery into which one is to look. The distance further that one is able to see with the aid of the prism is of a sufficient degree to make it of distinct advantage when an ophthalmoscopic examination is desired of the extreme periphery of the fundus.

OCULAR MOVEMENTS. DR. CORNELIS D. VERRIJP, Leyden, Holland.

This article will be published in full in a later issue of the ARCHIVES.

DISCUSSION

DR. MARK SCHOENBERG: Dr. Verrijp has presented a very difficult subject, and he has treated it clearly. He seems to have proved quite

conclusively that there are several centers of rotation for the eyeball. These centers are shifted from one position to another according to the direction of the visual axis at a particular moment. This sounds intelligible and probable when one considers the movements of one eyeball, but when one considers the movements of both eyeballs, things look very complicated.

Let us suppose that both eyes move 30 degrees to the right. The center of rotation of the right eye will shift from the primary position to that corresponding to the new position. In the left eye the same thing will happen, but the group of muscles moving the right eye to the right is different from the muscular group directing the left eye to the right, consequently we expect that the centers of rotation will not shift in the same manner and the same amount in both eyes. The result would be a decided difficulty in the correct direction of the visual axes toward the fixated object.

However, we cannot deny that such a perfect coordination of the centers of rotation and visual axes of both eyes is taking place, and I wish to hear how Dr. Verrijp explains this coordination.

Perhaps a study of both eyes by Dr. Verrijp's method would explain this point that puzzles me.

DR. CORNELIS D. VERRIJP: I have never carried on experiments with both eyes; it is not impossible to do this, but it certainly is much more difficult technically. I think that it is not absolutely necessary that both eyes move in the same way. Suppose we have an object here (drawing on blackboard), and both lines of sight are directed to that object. Now, if we assume that the accommodation of one eye may be slightly different from that of the other one, it is possible that the situation of both eyes along the line of sight is different. In fact, this different situation is necessary in any binocular fixation in which the object is not at equal distances from both eyes. The only thing which is important is that we get, on the central area of the retina, a satisfactorily sharp image of that part of the object which we fixate. According to such a point of view, it is even probable that the path of each eye will be different.

THE VISION OF PRESCHOOL CHILDREN. AN ANALYTICAL STUDY OF 982 CHILDREN BY THE NATIONAL SOCIETY FOR THE PREVENTION OF BLINDNESS. DR. B. FRANKLIN ROYER.

The general rule for reference on the acuity of vision test was inability with the worse eye to indicate accurately the direction the legs of the E pointed at the 30 foot line or higher. All deviations from normal appearance of eye tissues and all fixed and latent squints were referred for study to the twelve oculists doing the work.

More than 70 per cent of the children examined had a visual acuity of 20/30 or better; more than 20 per cent had less than 20/30.

This study seems to indicate that almost as large a percentage of children of preschool age have eye defects requiring careful study by ophthalmologists as have children in the older age groups. The only striking difference that stands out clearly in this study is the higher incidence of hyperopia and the lower incidence of myopia in the preschool group.

It would seem that latent squint in early age groups, as brought out by cover tests, is more frequent than has been taught generally, and that ophthalmologists would do well to devote more study to this phase of eye welfare. Irregular ocular movements, for which we have used loosely the term, muscle imbalance, were more frequent among these preschool children than is recorded among older children.

Our figures show that out of the 982 preschool children, 206 (20.9 per cent) had some abnormal condition of the eye. As might be expected, many of them had associated two types of abnormality. Refractive errors were present in 178 children (18.1 per cent); squint or muscle imbalance in 46 children (4.7 per cent); inflammatory conditions of the lids or conjunctivae, in 28 (2.9 per cent); the more serious diseases of the eyeball, in 14 (1.4 per cent). Out of the total there were 658 children rated as apparently normal by the ophthalmologists and nurse. The exact eye condition of 118 children set aside for extended study remains undetermined. Probably about 100 of them would have been classified definitely as having some abnormality had it been possible to secure complete studies of each.

The figures show a general trend toward increase in the proportion of children having 20/20 vision from the third to the sixth birthday, accompanied by a decrease in the percentage with 20/30 vision, and a noticeable, although not quite so rapid, decrease in the amount with vision of 20/40 or less. This may be an indication that visual acuity among children at certain preschool ages tends to improve during the process of growth, training and development of the child.

The girls seem to have slightly lower visual acuity than the boys. There are fewer in the 20/20 group at each age and more in most of the groups below normal.

As would be expected for a preschool age group, most of the errors found were hyperopic (hyperopia, 7.1 per cent; compound hyperopic astigmatism, 7.5 per cent; and simple hyperopic astigmatism, 1.6 per cent). Myopia and myopic astigmatism together were found in only 1.3 per cent of the cases and mixed astigmatism in 0.3 per cent.

While we do not have much faith in the reliability of the data on nativity, certain outstanding points are of interest, notably the high rate of squint and low rate of astigmatism among the children of Irish parents, the comparatively high rates for myopia and astigmatism among the Chinese, and the consistently low rate of astigmatism of the colored groups.

The range of error was from +7 diopters of hyperopia to —10 diopters of myopia, but 75 per cent of the cases were between +3 diopters of hyperopia and —3 diopters of myopia. The median was about +2 diopters of hyperopia. In respect to the degree of error, the median for girls (+2.04) is below that for boys (+2.15), but this does not mean that the errors of the girls are less serious for they actually have a higher percentage of myopia.

An attempt was made to ascertain whether there is any correlation between the incidence of abnormalities of the eye and of other physical defects noted in examinations by pediatricians. No marked tendencies were discovered, and we feel that our data on this point is too meager for presentation.

In the judgment of several ophthalmologists cooperating in this work, the largest contribution has been the development of a technic

of testing the acuity of vision of little children which is based on sound psychologic principles. By skilfully utilizing this technic a better acuity of vision test may be obtained as a check against retinoscopic and other measurements of refractive errors.

NOTE.—The entire study covers the work of (1) a staff associate and several volunteers who were trained to sort out (350 in 982) children whose eyes and vision deviated from what was agreed on as apparently normal; and (2) the observations of twelve ophthalmologists who made extended studies of the eye condition of 206 children having some defect or abnormality and of 26 children dismissed as practically normal. The ophthalmologists giving of their time in this study and most of them the services of their offices and equipment were: Doctors H. Robertson Skeel and Colman W. Cutler of New York City; John N. Evans, John H. Ohly, Walter V. Moore, Charles A. Hargitt, Walter Moehle, William B. Agan, R. Cutino, M. J. Buonaguro, J. M. Nova and Joseph di Rocco of Brooklyn.

DISCUSSION

DR. JOHN N. EVANS: Any sort of collected material is without doubt open to misinterpretation. Making due allowance for such defects, we must all admit that drawing conclusions from the impressions we gain through clinical routine is much less satisfactory. The critical review of our office records over and again has compelled us to revise such impressions.

The bringing together of so much material from the hands of so many workers is certainly a valuable accomplishment, and without doubt Dr. Royer and the National Society for the Prevention of Blindness have made a contribution of real value to ophthalmology.

Particularly to be commended is the use of the illiterate E chart. Dr. Royer's wife has developed a system which, when properly applied, gives results of a very dependable nature. She has become an authority on this type of testing through her examination of thousands of children. A detailed description of her methods, with notes on the interpretation of the children's responses, would be a valuable addition to the report.

In 1918, a study was made of the undirected drawings of about 3,000 children of the preschool age, and a chart was devised using the characters which most frequently occurred in their picture-writing (Evans, J. N.: Optotype for Young Children, *Am. J. Ophth.* **2:** 425 [June] 1919; Ophthalmic Aspects of Pediatrics, *Arch. Pediat.* **38:** 539 [Sept.] 1921). This "Optotype for Young Children," while satisfactory for the office case, did not lend itself so well to the dispensary type or to such group study as the National Society has sponsored. I have discarded it for the better system used in the study just reported by Dr. Royer.

Too much stress cannot be laid on the importance of determining the visual acuity of small children. Such vital problems as those of acquired and congenital amblyopia cannot be unravelled by the cruder methods heretofore accepted.

It will be recalled that Worth (Worth, C.: Squint, ed. 5, Philadelphia, P. Blakiston's Son & Company, 1921, p. 85) used small white balls which he rolled about on the floor in an effort to determine the visual acuity of small children. This obviously was merely a test of

the ability to recognize motion—a much more primitive sense than that of form. On this and equally unsound methods, Worth's theories of acquired and congenital amblyopia have been founded. Our understanding of many problems has been more confused than clarified by the general acceptance of such evidence. The work of the National Society should be encouraged, and if possible a new series of studies commenced along the same lines in orphanages and like institutions where the children can be controlled and rechecked during many years.

A complete review of the world's literature would be complementary to the present study, and publication of this first step in a great work should be of inestimable value as a step toward the prevention of blindness.

DR. CORNELIS D. VERRIJP: I want to remark about some things which struck me while looking at the graph. When we study a certain property of a great number of persons, we get distribution curves like this (illustrating on blackboard), and the maximum is more or less in the middle. It strikes me that the curve of visual acuity which you obtained is much more toward the left side. We know that the actual largest visual acuity which is possible is larger than the Snellen one. Snellen gives 20/20, or 6/6, which he originally gave, which does not correspond to the largest visual acuity which is possible, because it corresponds to an angle of one minute. We know that under bright illumination we can have a visual acuity which is larger, so it might be that that curve, when you reckon with a still larger visual acuity, would give another type of curve (illustrating on blackboard), because there would be a certain number of children in the group who would shift from the 20/20 in which they are classified now to a higher visual acuity.

DR. ROYER: I do not think I can add anything to what Dr. Verrijp has suggested by that particular graph. The graphs shown, which were peak-shaped, on one side recorded the hyperopia by diopters and on the other side the myopia by diopters. The acuity of vision was not plotted by a curve graph. We tried to standardize the light and to keep to exactly the same number of foot candles, always using artificial light and always using from 10 to 12 foot candles of light.

COLLEGE OF PHYSICIANS OF PHILADELPHIA, SECTION OF OPHTHALMOLOGY

A. G. FEWELL, *Reporter*

Dec. 19, 1929

C. E. G. SHANNON, M.A., *Chairman*

FURTHER REPORT ON CASE. DR. BURTON CHANCE

Further report was made on the case of the little boy who was exhibited at the November meeting, with a condition which was believed to be glioma. The eye was enucleated a few days after the meeting.

The mass had increased so extensively that it was almost impossible to find any ordinary reflex when the ophthalmoscopic examination was made. Dr. DeLong and Dr. Chance are still attempting to find something more definite; up to the time of this meeting, nothing but exudative products have been found in the sections. They are forced to state that it is not a case of glioma.

PAGENSTECHER'S SUTURES FOR PTOSIS. DR. BURTON CHANCE.

A young man was brought before the section to show the effects of so simple a procedure as that of buried suturing. At first consultation the patient showed that the right upper lid covered the eye and could not be elevated, but, now, the patient is able to open the fissure to the full width. The sutures were made of rather thick, heavy and rough silk, and a short, broad needle curved on the flat, was used so that in the cicatrization following, the tract was quite wide. The sutures came out one after another, on being tightened day by day. The tracks thus made are cicatrizing and contracting so that there is a fairly wide fissure which it is hoped may be permanently maintained. What shall be required later is problematic, yet, at present, the result is quite satisfactory, and, therefore, perhaps nothing else will be required.

A CASE FOR DIAGNOSIS. DR. MARY BUCHANAN.

A boy, who had been brought to the clinic at the Woman's Hospital from Coatesville, was shown before the section. He was very much frieghtened and no important history could be obtained. About eight months previous to examination, something white was noticed in the pupil of the patient's left eye. There was no history of injury; the eye did not hurt and did not seem to bother him at all.

The pupil did not dilate and appeared to be bound down. The child could not count fingers, but the next day after a solution of atropine was used, he counted fingers at a distance of 8 inches. The light projection was very poor. There were calcareous deposits in the lens, which was cataractous. There was no view of the fundus. Transillumination was tried but was unsatisfactory, as the child began to cry. As no slit-lamp was available, this examination could not be made.

Dr. Buchanan wished to know whether there was any immediate danger from keeping this eye in, and if there was a possibility of the condition being due to a new growth.

DISCUSSION

DR. WARREN REESE: I believe that I have seen this boy before and I am much interested, particularly in the corneal condition which I believe to be a zonular keratitis. I thought this was rare in such a young person, although I have seen another similar case.

DR. BURTON CHANCE: If the disease of this eye is not dependent on the retention in it of a foreign body, the present appearance reminds me of certain cases of metastatic deposits I have seen in the course of acute infectious diseases, in which there were signs of uveitis of progressive severity.

DR. WILLIAM ZENTMAYER: In connection with Dr. Reese's observation I have recently seen in consultation with Dr. Heed, a girl, aged 6, with bilateral uveitis in which both eyes showed a beginning zonular opacity of the cornea. In one eye, vision was limited to light perception and in the other eye it was nearly normal.

DR. E. A. SHUMWAY: Has a roentgenogram of the eye been taken? I wish to remind the section of a case of Dr. John Carpenter, in which an eye had been removed for panophthalmitis supposedly due to an attack of mumps. Microscopic examination later, however, showed the presence of a piece of steel which had flown into the eye when the patient, as a boy, was standing beside a blacksmith's anvil.

DR. MARY BUCHANAN: The possibility of a foreign body had been considered at first on account of the position of the two linear corneal opacities concentric with the limbus, but the roentgenogram was negative. The only history obtainable is that the child had tonsillectomy performed at the age of 4 and had been well since; there had been no recent illness. The maternal grandmother had tuberculosis.

A CASE EXHIBITING ACTIVE CIRCULATION IN THE POSTERIOR PART OF THE LENS. DR. CHARLES A. YOUNG.

A youth, aged 17, was first seen Oct. 15, 1929, complaining of pain in the left eye. Examination showed the following: vision without glasses, right eye, 6/4; left eye, 6/7.5 plus 1. Binocular vision was normal. Cycloplegia showed hyperopia in each eye. With a plus 0.75 sphere over the right eye the vision was 6/4 plus 4; with a plus 1.25 sphere over the left eye vision was 6/6 plus 2.

Near points no. 0.5 M type without glasses equalized 9 cm. in the right eye; in the left eye, 10 cm. The muscle balance was negative except for 12 degrees of exophoria at 33 cm. The left eye showed a small pterygium on the nasal side. Pupillary reactions and tension were normal in each eye.

Ophthalmoscopic examination of the right eye gave negative results. The left eye showed an opaque plaque slightly nasal to the antero-posterior axis of the lens, from which extended a persistent hyaloid artery which looked black with the ophthalmoscope. On rotating the eye upward and downward, the middle portion of hyaloid artery swung with the motion of the eye, but was fixed at both its anterior and posterior extremities.

Both Dr. de Schweinitz and Dr. Zentmayer were of the opinion that the hyaloid artery is attached to the inferior nasal branch of the central artery of the retina.

Examination with the corneal microscope showed an opaque plaque in which there were three capillary loops which showed active circulation and were branches of the hyaloid artery. The hyaloid artery had the appearance of a white band when the light was concentrated on the artery but with the light to one side it gave the red appearance of a blood vessel.

DISCUSSION

DR. GEORGE DE SCHWEINITZ: I have examined Dr. Young's patient with the slit-lamp, and found the conditions described, an unusual and highly interesting picture. I have been unable to find in Vogt's or Meesman's Atlas a plate of a similar condition.

DR. WILLIAM ZENTMAYER: As seen with the ophthalmoscope there are opaque lines radiating from the base of the attachment of the hyaloid artery to the posterior capsule of the lens. These are not the blood-bearing vessels seen with the biomicroscope but may be either folds in the capsule or empty vessels. The vessels seen with the biomicroscope are probably remains of the posterior vascular capsule of the lens.

UNILATERAL BUPHTHALMOS. DR. T. B. HOLLOWAY AND DR. A. G. FEWELL.

A negro girl with buphthalmos was presented before the section. The patient was 5 months of age when first seen in the eye clinic of the University Hospital in August, 1929. The mother had noticed, the day previous to examination, that something was wrong with the child's left eye. The child had never been ill, and had developed normally. There were two other children, both normal in every way. Neither the mother nor the father had ever had ocular trouble.

When first seen in the clinic, the right eye appeared normal in every way. The cornea was clear and measured 12.5 mm. The anterior chamber was of normal depth. The pupil measured 4 mm. and was active to light. Finger tension was normal. The left cornea was quite cloudy over its whole surface and measured 14 mm. The anterior chamber was deep, the pupil seemed dilated and very sluggish to light; the finger tension was plus. A mixture of 1 per cent pilocarpine and 0.25 per cent physostigmine (eserine) was ordered to be used in the eye four times daily. When seen two days later, the cornea was clear and it has remained so until the time of this meeting. The drops are still being used.

This case was presented because of the early age at which the buphthalmos appeared and also for suggestions as to treatment.

DISCUSSION

DR. T. B. HOLLOWAY: This case is of interest because it is unusual to see a case of buphthalmos at so early an age. This is the youngest patient with this type of case that I have seen. While the case has been described as a unilateral one, I believe that symptoms were beginning to develop in the other eye.

I first saw this case a month previous to this meeting, and at that time there were subacute signs, which cleared up after the administration of suitable miotics.

The patient had again reported, within a few days previous to the meeting, with a haze in the cornea, and the question came up as to what should be done for the tension. Practically all types of operative procedures appropriate for glaucoma have been resorted to for this condition, and to the best of my knowledge, with little success. At the Overbrook School for the Blind, there are certain students who have been operated on unsuccessfully. At this institution there is quite a group of students with buphthalmos manifesting all of the phases seen in the advance stages.

Not infrequently cases are seen in which the tension is plus in one eye and minus in the other, with the eye becoming atrophic.

I would appreciate the opinion of any of the members of the section as to what operative procedure would be best adapted to these cases or to this particular case. We have seen the child through two attacks, one acute and one subacute, and I expect that she will ultimately be seen at the Overbrook School.

DISCUSSION

DR. GEORGE DE SCHWEINITZ: Although buphthalmos is usually described as a bilateral disease, certainly in its earlier stages it is not uncommonly unilateral; witness T. R. Aynsley's recent interesting communication (*Brit. J. Ophth.* [Dec.] 1929) on "Buphthalmos and Naevus" in which ten cases of unilateral buphthalmos are listed, six of the right eye and four of the left eye. All of these patients are mentally defective, and give evidence of cerebral lesion, usually calcified meningeal nevus.

Girl twins were normal in all respects until the age of 6 1/2 months. After a short, ill defined illness, buphthalmos of the left eye began to develop in the form of enlargement of the globe, with a very hazy cornea and increased intra-ocular tension, which yielded temporarily to miotic treatment. The examinations were made some months ago, but I have received no information as to the present condition of these children. Referring to the operative treatment, my best operative results, at least temporarily, have followed repeated posterior sclerotomies as advocated by Haab, and this has been, I believe, the experience of my associate, Dr. Baer. I doubt the value of iridectomy; I have seen two satisfactory results from corneoscleral trephining, the operations having been performed by colleagues, but I do not know whether these results have been permanent.

DR. WILLIAM ZENTMAYER: Some years ago in preparing a paper on buphthalmos I sent out a questionnaire to most of the prominent eye surgeons in the country regarding the proper procedure in the treatment for this condition.

One surgeon with wide experience in Philadelphia stated that the only operation was enucleation. Dr. Weeks advocated trephining, which was then a comparatively new operation. Dr. de Schweinitz suggested the procedure of Haab, of repeated posterior sclerotomy. Gifford subsequently did a number of trephining operations with unsatisfactory results. His explanation of the reason one did not get filtration in these cases was that the conjunctiva was held close to the sclera because of the distention of the globe. My own experience has been very unfavorable with operation. I recall the case of an infant, who had very marked buphthalmos, on whom I performed an iridectomy. Most of the contents of the eye were expelled through the incision in the globe. Dr. Posey attempted cyclodialysis on the other eye of the patient but failed.

In the case which Dr. Peter showed before the section a few years ago in which he had done an iridectomy with very successful results in a beginning buphthalmos, he feels that repeated posterior sclerotomy is the only safe operative procedure, but the results are not satisfactory.

DR. B. F. BAER: I agree with Dr. de Schweinitz with reference to posterior sclerotomy being the best operative treatment in these cases, but my own feeling was that this only delayed the inevitable.

DR. BURTON CHANCE: In the case of a negro child, aged 2, who was under observation in my ward two years ago, I performed a sclerotomy with very satisfactory results. The child has been away from the hospital for many months but returned to-day, and I was greatly distressed to see that a great change had taken place, and to note that the eye looked very much like that gleaming gem, called cat's eye. The corneas are very edematous and the general discoloration of the sclera, ringlike. I was very much disappointed because the immediate results had been so good.

DR. T. B. HOLLOWAY: I wish to thank the gentlemen who have expressed opinions as to treatment for this condition, and I must confess that it is pleasing to be agreed with. I shall eventually have this child as a patient at the Overbrook School for the Blind. If the treatment does not give satisfactory results, posterior sclerotomy probably will be resorted to. Some of you may remember that Dr. Gifford reported the history of a case in which the sclera was trephined and a posterior sclerotomy was performed through the trephine opening. About six months before that case was recorded, a patient was sent to the University Hospital in the service of Dr. de Schweinitz. The chamber of the eye was so shallow that it was absolutely impossible to get any kind of an instrument into it. Trephining of the sclera was done and a puncture made through the opening, hoping to get some deepening of the anterior chamber. At the end of forty-eight hours the tension was as high as before operation.

Of all operative procedures, I think that posterior sclerotomy probably offers the most, chiefly because it can be readily repeated.

OPERATIVE TREATMENT FOR PULSATING EXOPHTHALMOS. DR. G. M. DORRANCE.

A new operation for the treatment of pulsating exophthalmos was devised because of the failure to obtain cure by ligation of the common carotid alone, and because of the danger of hemiplegia occurring when ligation of the internal carotid was practiced.

The observations of the following facts on a patient in whom Dr. Dorrance had ligated the common carotid, led to the method he now advocates.

On reoperation on this patient to determine why the ligation of the common carotid failed to cure the exophthalmos, Dr. Dorrance found pulsations present in both the internal and external carotids, this being due to collateral anastomosis between the two external carotids.

A clamp was placed on the internal, the external and the ascending pharyngeal arteries. If the clamp on the carotid artery was released, the blood pressed out of the vessels in the areas lying between the ligature on the common carotid and the clamps on the aforementioned vessels, and the clamp reapplied, this space remained empty. If the clamps on the internal carotid were released, the space would slowly fill up with blood. This blood was then pressed out of the space and the clamp reapplied. If the clamp was released on the external carotid the space would quickly refill; the same was true if the clamp was released on the ascending pharyngeal, but the influx was naturally much slower.

These observations convinced Dr. Dorrance that after ligation of the common carotid, the internal carotid became a branch of the external. With these facts in mind, the following operation was advocated: With the patient under local anesthesia, the common carotid is ligated; from ten to fourteen days later the following branches of the external carotid are ligated, either one or more at the second sitting, dependent on the amount of arteriosclerosis present: the superior thyroid, the lingual, the facial, the ascending pharyngeal and the occipital.

In the case shown, an excellent result was obtained.

DISCUSSION

Dr. T. B. Holloway: Dr. Dorrance was good enough to permit me to see this patient, some weeks ago. I feel that all the members of this section are familiar with the various combinations that have been resorted to in the ligation, and that slow ligation has been a distinct advance.

While it is true that the superior thyroid has been ligated in conjunction with the carotid, I know of no instance in which the various branches have been so treated, and in which the possibilities for such splendid control have been demonstrated. Dr. Dorrance is to be congratulated on his ingenious technic and his excellent result. The incidence of ligation of the carotid for pulsating exophthalmos is quite well established; it is approximately 8 per cent. However, I have never felt satisfied that the statistics concerning cerebral complications following ligation of the carotid were reliable, and this is one of the reasons why I have never been in accord with those who have been so apprehensive about the orbital operation. Further, those same persons have no hesitancy about an exenteration of the orbit, when these same structures are severed at the very apex of the orbit and are much closer to the cavernous sinus than would be the case where ligation was resorted to.

Do Corneal Scars Move? A Preliminary Report of a Clinical and Biochemical Study. Dr. Benjamin W. Key.

The character of the corneal scar which may shift its position in corneal substance was described. This is the newly formed scar, or one recently cicatrized, of the slanting cut variety or irregular laceration type (so-called linear scar), located in the superficial or deep substance of the cornea and involving the pupillary area just below the horizontal median line. Cases were cited indicating a shifting of the scar's position downward and toward the limbus after a period of from one to four years. Measurements as to the size and location of the scar in order to avoid errors in observation were noted in detail in the attempt to determine definitely this corneal change. The extent of this change is admitted to be very limited, not more than from 1.5 to 2 mm., but when viewed in comparison with its area of location (the lower half of the pupillary area) it represents a change of some significance.

A brief of the more recent studies of wound healing and regeneration of the cornea, the formation of a corneal cicatrix, and the interpretation of these cellular changes was presented. An analysis of the

physiologic and chemical influences which may explain the shifting of a scar's position was offered. It was suggested that the anatomic structure of the cornea with its biochemic activity (demonstrated under the microscope and by experiment), its migratory cellular content and its fluid composition (about 90 per cent of its volume is water) may permit this change to occur in time through fibrous contraction, tissue tension, pressure exertion of the lids and possibly through functional stimulus induced by adjoining structures or by the action of sunlight.

SUBCONJUNCTIVAL INJECTION OF A COMPLEX HYPOIODITE PREPARATION (PREGL'S SOLUTION) IN THE TREATMENT FOR GONORRHEAL OPHTHALMIA. DR. ALFRED COWAN AND DR. SEARLE H. LANYON.

A series of six cases of gonorrheal ophthalmia in adults treated by subconjunctival injections of a complex hypoiodite preparation (Pregl's solution) were reported. Fifteen minims of the solution was injected under the highest point of the chemotic bulbar conjunctiva, every day as long as the laboratory report showed the presence of gonococci.

The duration of the infection for the six cases treated was respectively thirteen, six, five, three, seven and five days, an average of 6.5 days. In case 5, given as of seven days' duration, the patient was practically free from organisms in three days, only a few gonococci having been left on the sixth and seventh days.

Useful vision was lost in only one of the eyes. This was in a man, aged 73, whose cornea was already nearly opaque on admission. In four of the cases, the vision was unaffected and in one, the vision was 6/12.

One other feature should be considered in this series; in no instance was more than one eye involved. This, of course, must be credited to good nursing and careful prophylaxis. Whether or not the treatment had any bearing on this, cannot be said.

ROYAL SOCIETY OF MEDICINE, OPHTHALMIC SECTION, LONDON

H. DICKINSON, *Reporter*

Jan. 10, 1930

CYRIL H. WALKER, *F.R.C.S., President, in the Chair*

EXCISION, FOLLOWING LACERATIONS BY WIRE. MR. MCCALLUM.

The eye from a patient whose case had been previously brought before the section was shown with some copper wire embedded in it. When the patient was exhibited he had some cystitis, and it did not seem possible to remove the foreign body without causing a good deal of damage. It was, on the advice of members, subjected to excision. The specimen showed it would have been useless to fish for the foreign body in situ.

MELANOTIC SARCOMA OF THE CHOROID. MR. MCCALLUM.

A man, aged 37, came under the exhibitor's notice three days after becoming aware that the right eye was defective. Vision in that eye allowed no more than the perception of hand movements. In the fellow eye, the vision was 6/5. A tumor was occupying the inner part of the fundus. The eye, having been excised, was exhibited. The tumor had occupied the ciliary region, and was seen to be stretching backward toward the optic disk. The suggestion was advanced that it might be cysticercus, since the man had resided in several places abroad and had suffered from several tropical diseases. A further suggestion was that it might be sarcoma of the choroid. The blood revealed no eosinophilia, and a thorough examination of the stools did not reveal parasites or eggs in the intestinal contents. Routine roentgenography showed a root abscess in the right upper jaw, and two apical dental abscesses On dental advice, the mouth was cleared. Tonometric measurement gave a reading of 16, and of the good eye of 22.

Eleven days after first seeing the patient, Mr. McCallum thought there was a fuller aspect about the tumor, and there was a torpedo-shaped retinal hemorrhage placed horizontally. He therefore removed the eye. The growth was found to be melanotic sarcoma. The pathologic report was that of a circumscribed sarcoma, slightly pigmented in parts, and probably arising in the outer layers of the choroid. There were spindle cells. There was no evidence of extra-ocular extension through the usual channels; the angles of the anterior chamber were free.

PERSISTENT HYALOID CANAL. MISS SMITH CLARKE.

The patient was a premature boy, born at 8 months and 1 week. He was strong, except for the condition of the eye. The other eye showed a slight trace of hyaloid canal. There was a vision of 6/6, and very little refractive error.

SEMITRANSLUCENT FIBERS RADIATING FROM THE DISK. MISS ADAMS AND MR. WILLIAMSON-NOBLE.

A man, aged 55, complained of defective vision in the right eye and was found to have translucent fibers radiating from the disk.

There was no corresponding scotoma. The fibers did not originate from the edge of the disk.

THE INFLUENCE OF THE PARAFOVEAL ON THE FOVEAL REGION OF THE RETINA. MR. F. W. EDRIDGE-GREEN.

The demonstration of this influence constituted a conclusive proof of the accuracy of Mr. Green's theory of vision, i. e., that the rods were the nerve elements which controlled the visual substance. This visual substance was liberated into the liquid surrounding the cones, and was flowing all the time, except during sleep, toward the center and out through the optic nerve. He advanced that theory in 1889, and facts supporting it had been increasing ever since. The fovea contained only cones, therefore the foveal region had to be sensitized from the periphery. By glancing up after looking directly on to a bright light, one saw circles contracting and breaking up into a star

figure. That explained the observation, for which Helmholz was unable to give a reason, that at one moment the fovea was blind and at another moment it was the most sensitive part of the retina. If, on awakening in the morning, one looked at the ceiling, a black spot was seen, but on waiting with the eyes under the bedclothes until one of the circles had broken up, one saw the fovea as a dazzling star.

A dark object 2 inches in diameter in the middle of an area of red was placed on the epidiascope, and the members invited to fix it with one eye during such a period that the black object became merged in the area of red, and so was apparently obliterated. In asking that only one eye be used an obvious criticism was anticipated, that if both eyes were used the occurrence might be attributed to convergence, and that was impossible with the use of only one eye. Placed on a patterned carpet such a dark object appeared, after gazing, to be transparent. The colors from the periphery had flown over into the fovea. If one placed red on green, one saw a flowing in of the spiral wave, and where the green impinged on the red, the red changed to yellow before the whole of the green was entirely obliterated. A dimmer light than daylight was better for those who had difficulty in seeing the effect.

In the short discussion several members suggested that the effect was due to a mental impression, but Dr. Edridge-Green replied that it could not be so, as one could not have anything moving in the cerebrum. He added that when the eye was moved, the muscles of the eye put pressure on the retina and drove the fluid in an irregular way. That was his explanation of miners' nystagmus: that when faced with the black surface of coal the visual purple did not flow in properly, and in order to secure that flow, the eye was moved.

A Microphthalmic Family. Mr. Eugene Wolff.

The parents of this family were first cousins, their mothers having been sisters. There were now ten children of the family alive, five of whom had small eyes (three male, two female). The children so affected were the first, third, fourth, eighth and tenth. In most of the cases of microphthalmos on record there was an additional malformation, such as cataract, coloboma of the iris and choroid, and often these combined with nystagmus. In most instances, the patients had poor vision, even with correction. In the present family, however, the small eyes were the sole defects. They were all high hypermetropes, with but little astigmatism, and at one time they had had reasonably good vision. There was some ptosis associated with narrow palpebral fissures and small orbits. The eyes were deeply set, so that the lower orbital margin, which normally formed no prominence, was visible.

It was not easy to decide when to call an eye microphthalmic, as all sizes were encountered. It was not possible to measure the antero-posterior diameter of the eyeball, and the size of the cornea was not an absolute indication. In the cases in this family, the cornea measured about 10 mm. in transverse diameter. The fifth child is now in Canada.

Priestly Smith had pointed out that these patients were more liable than others to glaucoma, because as a rule the lens was too large. In eyes which were smaller still, the lens was usually cataractous and small; probably in this way the eye was saved from glaucoma. Mr. Priestly

Smith reported the case of a man with abnormally small eyeballs with clear lenses who suffered from primary glaucoma, and whose daughter years later presented a similar maldevelopment with increased tension.

The eyes described in the first case were not panophthalmic, a rare condition. In that state, though the eyes were small, their refraction was emmetropic and they were infantile. Treacher Collins pointed out, in 1899, that the diameter of the cornea in intra-uterine life was more than half that of the whole eye, while in the adult it was less.

The premature baby in this family, the fourth child, was the most seriously affected. The unaffected brothers and sisters were married and had normal children, except that one had epileptic fits. None of the members of this family showed corectopia to any degree. Kotelmann found that the position of the pupil tended to vary with the race, and that in Patagonians it was normal to find ectopia pupillae upward and inward. Dr. E. A. Cockayne had shown him the following quotation from Charles Darwin's "Animals and Plants under Domestication": "In all cases of double microphthalmia brought under his notice he has at the same time met with defective development of the dental system." Three members of the family described had only two upper incisors.

The eighth child was said to have had a supernumerary row of teeth. Two theories had been advanced to account for microphthalamos: the developmental and the inflammatory. Possibly in the case of this family the consanguinity of the parents might have been an excitant to the arrest of development. In certain cases, syphilis had been blamed. There was no evidence of that disease in this family. As to the second theory, the inflammation might be in either the parent or the affected child.

KRUKENBERG'S SPINDLES. MR. J. D. N. CARDELL.

The patient was a man who was myopic and had received a blow on the left eye. There followed an opacity on the back of both corneas. These opacities were oval, 2.5 mm. in size and a rusty brown. There was no persistent pupillary membrane or sign of iritis. The fundi were normal. Pigment was circulating in the anterior chambers of the left eye only. The only change which had occurred at the end of five weeks was that the circulation of pigment had ceased in the left eye. Since then, this patient had been lost sight of.

Since 1899, details of thirty-one cases of the kind had been published: 71.4 per cent of these were in females, and the average age of the patients was 46 years. In 93.8 per cent of the cases, the condition was bilateral. In 26.7 per cent, there were other congenital defects, while in 20 per cent there was an associated inflammation.

It was not yet agreed whether the condition was congenital or acquired.

GLAUCOMA. MR. GRAY CLEGG, Manchester.

Mr. Gray Clegg showed pictures of two cases of the kind which had been under his own care. The first patient had chronic glaucoma, and there was decided atrophy of the iris. One could see the pigment particles on the atrophic iris. The other patient also had chronic glau-

coma. On this case he had done a large peripheral iridectomy, after the method of David Little. To the right the distribution of the pigment particles was sharply defined, while to the left they shaded gradually off. He thought that it might be a gravitational effect, but found that the patient slept on his right side.

DISCUSSION ON PAPERS BY MR. CARDELL AND MR. CLEGG

MR. CHARLES GOULDEN: I did not think that these cases were so rare as was usually supposed. In the cases I have seen the aggregation of pigment did not reach to the angle of the anterior chamber; they were no higher than the middle of the pupil. I thought the deposition of the pigment in this way was due to convection currents in the aqueous. An earlier observation consisted of the injection of fluorescein into a vein in the ear of a rabbit, when it was seen in a line on the back of the cornea, in the position of a Krukenberg spindle.

Book Reviews

HIGH FREQUENCY THERAPY IN OPHTHALMOLOGY. By A. MONBRUN and M. CASTERAN. Price, 16 francs. Pp. 127. Paris: Masson & Cie, 1929.

This book is one of a recent French series of practical handbooks. The authors, after discussing the theory and technic of medical and surgical diathermy, fulguration and the medical use of high tension currents, consider the various ocular diseases in which these methods are of service, with the indications for the particular kinds of treatment which they recommend. Their judgment is based on a large experience in the Paris hospitals, especially the Hotel Dieu under Professor Terrien. The relatively simple apparatus required, including the few special instruments necessary for ophthalmologic practice, is described. The current must be much weaker than that used in ordinary diathermy, usually below 500 milliamperes; hence a special milliamperometer is required.

The authors believe that an attempt to use diathermy for intra-ocular conditions is dangerous, and have confined their work to conditions of the lids, conjunctiva and cornea. In medical diathermy, the small active electrode is applied over the closed lids or to the conjunctiva, deep heat so generated being of value in atonic corneal ulcers, neuroparalytic keratitis and follicular conjunctivitis. Healing of ulcers of the skin is promoted. A marked analgesic effect is produced in the severe neuralgia of herpes zoster. Surgical diathermy employs the same principle, but the use of a very small active electrode, such as a needle, generates heat so intense as to produce coagulation necrosis. This means that tumors of the lids may be destroyed without any bleeding and with a minimum of scarring, since they may be attacked in stages instead of requiring the removal of a zone of healthy tissue during one surgical intervention. The coagulated tissue acts as a protective dressing until healing beneath it is complete; hence the scars produced are inconspicuous and have no tendency to shrink. Conjunctival bands divided in this way are said to be replaced by scars that do not retract and hence need not be covered by skin grafts as after the surgical removal so often employed to allow wearing of a prothesis.

Small chalazions, especially involving the free border of the lid, are conveniently destroyed by surgical diathermy. Lashes may be destroyed more quickly and with much less pain in this way than by electrolysis. For this purpose and for the removal of pterygia, a special method with a single electrode allows delicate and safe localization of the heat. For eviscerating the orbit in the case of recurrent tumors, the use of two active electrodes is advised, which allows carefully localized coagulation without the danger of producing bony necrosis.

Fulguration or the cold spark, which employs currents of high tension and destroys by purely mechanical effect without the generation of

heat, is less suitable for ophthalmologic conditions, but is of use in superficial tumors of the lid or in severing small conjunctival bands.

The dangers of diathermy are due to the deep effect of the heat generated, and to avoid them a simple technic must be rigidly adhered to. The method is contraindicated in the presence of acute infectious processes.

S. R. G.

Directory of Ophthalmologic and Otolaryngologic Societies *

FOREIGN

Oxford Ophthalmological Congress

Master: Dr. A. B. Cridland, Salisbury House, Chapel Ash, Wolverhampton, England.
Secretary: Dr. C. G. Russ-Wood, 12 St. John's Hill, Shrewsbury, England.
Place: Oxford. Time: July 10-12, 1930.

Deutschen Ophthalmologischen Gesellschaft

Secretary: Prof. A. Wagenmann.
Place: Heidelberg. Time: June 12-14, 1930.

NATIONAL

American Medical Association, Section on Ophthalmology

Chairman: Dr. T. B. Holloway, 1819 Chestnut St., Philadelphia.
Secretary: Dr. William C. Finnoff, Imperial Bldg., Denver.
Place: Detroit. Time: June 23-27, 1930.

American Academy of Ophthalmology and Oto-Laryngology

President: Dr. William H. Wilder, 122 S. Michigan Ave., Chicago.
President-Elect: Dr. J. F. Barnhill, Miami Beach, Florida.
Executive Secretary: Dr. William P. Wherry, Medical Arts Bldg., Omaha.
Place: Chicago. Time: October, 1930.

American Ophthalmological Society

President: Dr. W. Campbell Posey, Radnor, Pa.
Secretary: Dr. Emory Hill, 501 E. Franklin St., Richmond, Va.
Place: Hot Springs, Va. Time: June 2-4, 1930.

SECTIONAL

New England Ophthalmological Society

President: Dr. S. Judd Beach, 704 Congress St., Portland, Maine.
Secretary-Treasurer: Dr. E. B. Dunphy, 520 Commonwealth Ave., Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

Pacific Coast Oto-Ophthalmological Society

President: Dr. Arthur Jones, 105 N. 8th St., Boise, Idaho.
Secretary-Treasurer: Dr. Walter F. Hoffman, 817 Summit Ave., Seattle.
Place: Victoria, B. C. Time: September 3-5, 1930.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. Will Otto Bell, Medical-Dental Bldg., Seattle.
Secretary-Treasurer: Dr. Francis A. Brugman, Medical-Dental Bldg., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

Southern Medical Association, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Fred Hasty, 119 Seventh Ave., Nashville, Tenn.
Secretary: Dr. Fletcher D. Woodward, Box 162, University, Va.
Place: Louisville, Ky. Time: November, 1930.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

STATE

Colorado Ophthalmological Society

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. Donald H. O'Rourke, 217 Imperial Bldg., Denver.
Place: First floor, Metropolitan Building, Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive.

Eye, Ear, Nose and Throat Club of Georgia

President: Dr. George B. Smith, Rome.
Secretary-Treasurer: Dr. William O. Martin, Jr., 384 Peachtree St., Atlanta.

Indiana Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. A. Van Osdol, 320 N. Meridian St., Indianapolis.
Secretary: Dr. Robert J. Masters, 23 E. Ohio St., Indianapolis.
Place: Indianapolis. Time: December 10 and 11, 1930.

Minnesota Academy of Ophthalmology and Oto-Laryngology

President: Dr. C. N. Spratt, 900 Nicollet Ave., Minneapolis.
Secretary-Treasurer: Dr. J. H. Morse, 80 S. 7th St., Minneapolis.

Montana Academy of Oto-Ophthalmology

President: Dr. Lee W. Smith, 125 W. Granite St., Butte.
Secretary: Dr. J. G. Parsons, Lewistown.

North Dakota Academy of Ophthalmology and Otolaryngology

President: Dr. George M. Constans, Bismarck.
Secretary-Treasurer: Dr. F. L. Wicks, Valley City.

Oregon Academy of Ophthalmology and Oto-Laryngology

President: Dr. J. W. McCollom, 346½ Washington St., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

Rhode Island Ophthalmological and Otological Society

President: Dr. J. E. Raia, 276 Broadway, Providence, R. I.
Secretary: Dr. F. W. Dimmitt, 195 Thayer St., Providence, R. I.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

Utah Ophthalmological Society

President: Dr. F. M. McHugh, 17 Exchange Pl., Salt Lake City.
Secretary-Treasurer: Dr. H. Leroy Smith, Ezra Thompson Bldg., Salt Lake City.

Virginia Society of Oto-Laryngology and Ophthalmology

President: Dr. H. B. Stone, 303 1st St., S. W., Roanoke.
Secretary-Treasurer: Dr. Fletcher D. Woodward, Box 162, University.

LOCAL

Academy of Medicine of Northern New Jersey, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Frederick J. Wort, 1080 Broad St., Newark.
Secretary: Dr. Earl LeRoy Wood, 31 Lincoln Park, Newark.
Place: 91 Lincoln Park South. Time: 8:45 p. m., second Monday of each month.

Academy of Medicine of Toronto, Section of Ophthalmology

Chairman: Dr. Louis Joseph Sebert, 86 Bloor St., W., Toronto.
Secretary: Dr. Alexander E. MacDonald, 151 Bloor St., W., Toronto.
Time: First Monday of winter months.

ATLANTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Leon E. Brawner, 157 Forrest Ave., Atlanta, Ga.
Secretary: Dr. William O. Martin, Jr., 384 Peachtree St., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St. N. E. Time: 8 p. m., last Thursday of each month.

BALTIMORE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Leo J. Goldbach, 1012 N. Charles St., Baltimore.
Secretary: Dr. Angus Lloyd MacLean, Johns Hopkins Hospital, Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

BROOKLYN OPHTHALMOLOGICAL SOCIETY

President: Dr. Robert M. Rogers, 680 St. John's Pl., Brooklyn.
Secretary: Dr. William F. C. Steinbugler, 515 Ocean Ave., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday of February, April, May, October and December.

BUFFALO OPHTHALMOLOGIC CLUB

President: Dr. E. E. Blaauw, 190 Ashland Ave., Buffalo.
Secretary-Treasurer: Dr. A. F. Luhr, Medical Arts Bldg., Buffalo.

CHICAGO OPHTHALMOLOGICAL SOCIETY

President: Dr. Charles G. Darling, 30 N. Michigan Ave., Chicago.
Secretary: Dr. Richard C. Gamble, 30 N. Michigan Ave., Chicago.
Place: Medical and Dental Arts Club. Time: Third Monday from October to May.

CLEVELAND ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

Chairman: Dr. M. Paul Motto, Rose Bldg., Cleveland.
Secretary: Dr. A. D. Ruedemans, Euclid and E. 93d St., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

CLEVELAND OPHTHALMOLOGICAL CLUB

Chairman: Dr. W. E. Bruner, Guardian Bldg., Cleveland.
Secretary: Dr. M. P. Motto, Rose Bldg., Cleveland.

COLLEGE OF PHYSICIANS, PHILADELPHIA, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Maxwell Langdon, 1530 Locust St., Philadelphia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

DALLAS ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. D. L. Bettison, Medical Arts Bldg., Dallas, Texas.
Executive Secretary: Dr. W. Mood Knowles, Medical Arts Bldg., Dallas, Texas.
Recording Secretary: Dr. L. A. Nelson, 4105 Live Oak, Dallas, Texas.
Place: Dallas Athletic Club. Time: 6 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

DETROIT OPHTHALMOLOGICAL CLUB

Chairman: Members rotate alphabetically.
Secretary: Dr. Parker Heath, David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

EASTERN NEW YORK EYE, EAR, NOSE AND THROAT ASSOCIATION

President: Dr. John P. O'Keefe, 251 State St., Albany.
Secretary-Treasurer: Dr. Arthur F. Holding, 142 Washington Ave., Albany.
Time: Third Wednesday of October, November, March, April, May and June.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. W. R. Thompson, 510 Main St., Fort Worth, Texas.
Secretary-Treasurer: Dr. R. H. Needham, Fort Worth National Bank Bldg., Fort Worth, Texas.
Place: University Club. Time: 6:30 p. m., first Friday of each month except July and August.

Houston Academy of Medicine, Eye, Ear, Nose and Throat Section

President: Dr. Claude C. Cody, 1306 Walker Ave., Houston, Texas.
Secretary: Dr. J. M. Robison, Eye, Ear, Nose and Throat Hospital, Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., first Thursday of each month from September to June.

Indianapolis Ophthalmological and Oto-Laryngological Society

President: Dr. Robert J. Masters, Hume-Mansur Bldg., Indianapolis.
Secretary: Dr. Kenneth L. Craft, Hume-Mansur Bldg., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

Kansas City Society of Ophthalmology and Otolaryngology

President: Dr. L. R. Forgrave, Logan Bldg., St. Joseph, Mo.
Secretary: Dr. A. E. Eubank, Argyle Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

Long Beach Eye, Ear, Nose and Throat Society

President: Dr. W. B. Wright, Jr., 1209 Pine Ave., Long Beach, Calif.
Secretary-Treasurer: Dr. M. A. Schurter, 114 E. 7th St., Long Beach, Calif.
Place: Pacific Coast Club. Time: Last Wednesday of each month from September to June.

Los Angeles County Medical Society, Section on Ophthalmology and Otolaryngology

President: Dr. A. Ray Irvine, 727 W. 7th St., Los Angeles.
Secretary-Treasurer: Dr. J. Frank Friesen, 727 W. 7th St., Los Angeles.
Place: California Lutheran Hospital, Assembly Room. Time: 8 p. m., first Monday of each month.

Medical Society of the District of Columbia, Section of Ophthalmology and Oto-Laryngology

Chairman: Dr. Louis S. Greene, 1710 Rhode Island Ave. N. W., Washington.
Secretary: Dr. E. R. Gookin, Medical Science Bldg., Washington.
Place: 1718 M St. N. W. Time: 8 p. m., third Friday of each month.

Memphis Society of Ophthalmology and Oto-Laryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, Exchange Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

Milwaukee Oto-Ophthalmic Society

President: Dr. Edward R. Ryan, 425 E. Water St., Milwaukee.
Secretary-Treasurer: Dr. O. P. Schoofs, 120 E. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., third Tuesday of each month.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. R. J. Warner, 706 Church St., Nashville, Tenn.
Secretary-Treasurer: Dr. W. W. Wilkerson, Jr., Bennie-Dillon Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month.

New Orleans Ophthalmological and Otological Society

President: Dr. W. A. Wagner, Pere Marquette Bldg., New Orleans.
Secretary-Treasurer: Dr. M. F. Meyer, Canal Bank Bldg., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month from October to June.

New York Academy of Medicine, Section of Ophthalmology

Chairman: Dr. E. F. Krug, 12 W. 44th St., New York.
Secretary: Dr. William F. C. Steinbugler, 815 Park Ave., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

Omaha and Council Bluffs Ophthalmological and Otolaryngological Society

President: Dr. Charles M. Swab, Medical Arts Bldg., Omaha.
Secretary-Treasurer: Dr. J. C. Davis, 1615 Howard St., Omaha.
Place: Medical Tea Room. Time: 5:15 and 7:00 p. m., third Wednesday of each month from October to May.

Pittsburgh Ophthalmological Society

President: Dr. Edward B. Heckel, Jenkins Arcade Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

Pittsburgh Slit-Lamp Society

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: 121 University Pl. Time: Second Monday evening of every month, except June, July, August and September.

Rochester Eye, Ear, Nose and Throat Society

Chairman: Dr. A. Vincent Walker, 833 South Ave., Rochester, N. Y.
Secretary-Treasurer: Dr. John F. Gipner, 53 Fitzhugh St., Rochester, N. Y.
Place: Rochester Medical Assn., 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

St. Louis Ophthalmic Society

President: Dr. Charles W. Tooker, 308 N. 6th St., St. Louis.
Secretary: Dr. Carl T. Eber, 1006 Carleton Bldg., St. Louis.
Place: St. Louis or Washington University Cafeteria.
Time: 6:30 p. m., fourth Friday of each month from October to April, inclusive.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. F. W. Sorrell, Gibbs Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. A. F. Clark, 728 Main Avenue, San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

Spokane Academy of Ophthalmology and Otolaryngology

President: Dr. A. N. Codd, 421 W. Riverside Ave., Spokane, Wash.
Secretary: Dr. Marc Anthony, Old National Bank Bldg., Spokane, Wash.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. George H. Rockwell, Physicians Bldg., Syracuse, N. Y.
Secretary-Treasurer: Dr. A. Harry Rubenstein, Medical Arts Bldg., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.